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TECHNICAL SUPPORT DOCUMENTS

EPA REGULATIONS FOR PREVENTING THE SIGNIFICANT DETERIORATION OF AIR QUALITY

ENVIRONMENTAL PROTECTION AGENCY

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16. ABSTRACT

This document provides a detailed explanation of the technical and policy considerations which form the basis for EPA's regulations for preventing the significant deterioration of air quality, which were published in the Federal Register on December 5, 1974. The document discusses the reasons for rejecting various alternative plans for preventing significant deterioration of air quality; the basis for the air quality increments selected and the pollutants and sources covered; and the impact of the regulations on general growth and development as well as on new energy sources. A number of the references are included as appendices; however, several of the studies and reports referenced are too voluminous to include in this document. These reports are available for public inspection at EPA's Freedom of Information Center in Washington, D.C.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Prevention of significant deterioration	------	-----

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TECHNICAL SUPPORT DOCUMENT - EPA REGULATIONS FOR PREVENTING THE SIGNIFICANT DETERIORATION OF AIR QUALITY

U.S. Environmental Protection Agency
Office of Air Quality Planning & Standards

Research Triangle Park, N. C.

January 1975

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This document provides a detailed discussion of the technical and policy considerations which form the basis for EPA's regulations for prevention of significant air quality deterioration, which were published on December 5, 1974 (39 FR 42510). Generally, the body of this document contains a summary of each major issue and references more detailed materials which have been prepared on that issue.

I. Background

At the time the Administrator was required to approve or disapprove State Implementation Plans (SIP's), he believed that he was required under §110 of the Clean Air Act (the "Act") to approve SIP's which attained and maintained national ambient air quality standards promulgated under §109 of the Act. He did not believe that he had authority to disapprove SIP's which attained and maintained national ambient standards but did not prevent deterioration of existing air quality cleaner than the standards.

On May 24, 1972, the Sierra Club and other groups filed suit in the U. S. District Court for the District of Columbia seeking a declaratory judgment and injunction requiring the Administrator to disapprove all State implementation plans which did not contain procedures for preventing significant deterioration in any portion of any State where air quality is superior to national standards. On May 30, 1972, the District Court for the District of

Columbia granted the plaintiffs' motion and issued a preliminary injunction requiring the Administrator to review all State plans and "disapprove any portion of a State plan which fails to effectively prevent significant deterioration of existing air quality." (344 F.Supp. 253) The preliminary injunction also required the Administrator to promulgate regulations "as to any State plan which he finds, on the basis of his review, either permits the significant deterioration of existing air quality in any portion of any State or fails to take the measures necessary to prevent such significant deterioration." On November 1, 1972, the decision of the District Court was affirmed by the U. S. Court of Appeals for the District of Columbia Circuit on the basis of the District Court opinion. (4 ERC 1815) On June 11, 1973, the Supreme Court, by an equally divided court, affirmed the judgment of the Court of Appeals; no opinion was issued. (412 U.S. 541)

Each State plan has been reviewed in accordance with the preliminary injunction issued by the District Court. Although many State plans included regulations which have the potential for resulting in the attainment of air quality better than that required by the national standards, and although some State plans contained general policy statements indicating an intent to prevent or minimize deterioration of air quality, none was found to contain explicit and enforceable regulations for implementing such a policy.[1]

Accordingly, all State plans were disapproved by the Administrator on November 9, 1972 (37 FR 23836), insofar as they failed to provide for the prevention of significant deterioration. This disapproval did not affect the status of any previously or subsequently approved regulations designed to provide for the attainment and maintenance of national ambient air quality standards.

On July 16, 1973 (38 FR 18986), an initial notice of proposed rulemaking was published which set forth four alternative plans for preventing significant deterioration, and which solicited widespread public involvement in all aspects of the significant deterioration issue. A series of public hearings were held and over 300 written comments were submitted in response to this proposal. The hearing records and the written comments are available for inspection at the EPA Freedom of Information Office, 401 M Street, S.W., Washington, D. C.

Since neither the Clean Air Act nor the Court order define "significant deterioration," the initial proposals focused on the conceptual basis for regulations. The comments received on the proposed regulations therefore tended primarily to discuss conceptual issues such as the roles of federal and state/local governments, rather than detailed comments regarding implementation of the regulations. Accordingly, on August 26, 1974 (39 FR 31000), the Administrator reproposed regulations based on the conceptual approach he had determined appropriate. The purpose of

the reproposal was to focus more clearly on procedural and technical issues. Final regulations were published on December 5, 1974 (39 FR 42510).

Briefly, the regulations promulgated on December 5, call for the establishment of "classes" of different allowable incremental increases in total suspended particulates (TSP) and sulfur dioxide (SO_2). Class I applies to areas in which practically any change in air quality would be considered significant; Class II applies to areas in which deterioration normally accompanying moderate well-controlled growth would be considered insigificant; and Class III applies to those areas in which deterioration up to the national standards would be considered insignificant. All areas of the country are designated Class II initially, but provisions are included to allow States, Federal Land Managers and Indian governing bodies to request redesignation of any area to accommodate social, economic, and environmental needs.

The plan is implemented through a preconstruction review of specified source categories to determine whether these sources would cause a violation of the appropriate increments. The regulations also include a provision requiring the use of best available control technology on sources covered by the regulation. Finally, the regulation provides procedures for public comment on each application for permission to construct and for delegating

the responsibility for implementing the new source review procedures to States or local governmental units.

II. Reasons for selecting a three-class air quality increment plan

The decision to adopt a three-class increment plan was based on the conclusion that consideration of varying social, economic, and environmental factors in different areas would result in varying definitions of what is "significant."

Section 109 of the Clean Air Act requires the Administrator to establish national secondary ambient air quality standards, "to protect the public welfare from any known or anticipated adverse effects," including, as specified by section 302(h), "effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being." Such national standards must be based on air quality criteria which, under section 108, must "reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health and welfare which may be expected from the presence (of air pollutants) in the ambient air, in varying quantities." Thus, standard-setting under section 109 protects against demonstrable or predictable adverse effects which can be

quantitatively related to pollutant concentrations in the ambient air.

Limitations on air quality that result in cleaner air than the national ambient air quality standards cannot therefore be based on any quantitative measure of harm to either public health or welfare. This is not, however, to say that there are no possible unquantified adverse effects on public health or welfare below the levels of the national standards. Examples of such unquantified effects involve the transformation of sulfur dioxide into suspended sulfates and sulfuric acid aerosols, resulting in possible effects on health, visibility, climatic changes, acidity of rain, and deterioration of materials.[2]

Since there is no way to relate "significance" of deterioration of air quality to any adverse effects resulting from air quality levels cleaner than the national standards, EPA concluded that the determination of what is "significant" deterioration must take into account factors other than air quality alone. For example, relatively minor deterioration of the aesthetic quality of the air may be very significant in a recreational area in which great pride (and economic development) is derived from the "clean air". Conversely, in areas with severe

unemployment and little recreational value, the same level of deterioration might very well be considered "insignificant" in comparison to the favorable impact of new industrial growth with resultant employment and other economic opportunities.

EPA's belief that any determination of what deterioration increment should be prohibited as "significant" must take into account the practical effects of such determination is supported by the decision directing EPA to prevent such deterioration and the legislative history of the Clean Air Act. In its decision directing EPA to promulgate regulations preventing significant deterioration of air quality, the District Court relied heavily on language in the Senate Report on the bill that became the Clean Air Act (S.Rep. 91-1196, at 91st Cong. 2d Sess. at 2, 1970).

> "In areas where current air pollution levels are already equal to or better than the air quality goals, the Secretary shall not approve any implementation plan which does not provide, to the maximum extent practicable, for the continued maintenance of such ambient air quality." (emphasis added) *

The significant deterioration regulations have great potential impact on the nature, extent, and location of future industrial, commercial, and residential development

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* The requirement in these regulations that all new sources in the 18 listed categories use best available control technology is also part of the attempt to limit air quality deterioration "to the maximum extent practicable."

throughout the United States, and specifically their impact on the utilization of the Nation's mineral resources, the availability of employment and housing in many areas, and the costs of producing and transporting electricity and manufactured goods. The Administrator believes that it is most important to recognize and consider these implications, since the consideration of air quality factors alone provides no basis for selecting one deterioration increment over another.

Although some have argued that economic and social factors should have no bearing on the definition of significant deterioration and that only air quality factors should be considered in establishing a single nationwide definition of significant deterioration, none of the comments[3,4,5] suggesting changes to the increments proposed by the Administrator, or proposing alternate plans, offered any justification for the numbers which were selected.

It has been argued that the provision for Class III areas is unresponsive to the court's order in that it permits deterioration of air to the national standards in these areas. Although this result could also occur in Class I or Class II regions where the difference between existing air quality and the national standard is less than the prescribed air quality increment, all such comments focused on the provision for Class III areas.

Unless "significant deterioration" is defined as a percentage of the "unused" air resource, any air quality increment plan, regardless of how small the increment is, could allow deterioration up to the national standard in some instances. As discussed below, a plan that is dependent on a knowledge of existing air quality is virtually unworkable. Therefore, the fact that air quality could, in some instances, increase to the national standard does not, in the Administrator's opinion, make the regulations inconsistent with the Court's ruling or the Clean Air Act.

Since the regulations are based on the premise that the significance of deterioration must be determined partially on the basis of the practical effect of the determination and the present or intended use of the land (e.g., pristine recreational area or commercial-industrial area), the Administrator believes that the people in the area for which the determination is being made should make the determination of what level of deterioration should be considered significant. EPA lacks the resources or knowledge to determine what air quality deterioration would be considered significant in every area of the country. However, the Administrator will not approve requested designations which are arbitrary or capricious. *

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* Redesignations protested by other States or Indian Governing Bodies are discussed in Section X, infra.

III. Reasons for rejecting alternative plans

1. Volume averaging (Sierra Club Plan)

The details of this plan are presented in Reference 6. Under this plan, air quality deterioration would be defined in terms of the concentration of air pollutants averaged over a one kilometer sphere, the center of which would be the point emissions are released to the atmosphere. Although basically an air quality increment plan, the volume averaging plan is intended to limit the total amount of pollutants emitted to the atmosphere, rather than directly limit ground level concentrations. Although total atmospheric burden is better related to effects such as acid rain and visibility reduction than is ground-level air quality, most other unquantified effects at levels below the national standards are related to ground or near-ground level concentrations (corrosion rates, plant effects, suspected health effects, etc.). Since the use of ground-level air quality at individual points (as opposed to spatial averages) is consistent with the way the national ambient air quality standards (NAAQS) were established and the way attainment of the NAAQS is determined, the NAAQS provide a meaningful range of values from which to select an appropriate

deterioration increment. No such "guidance" is available under the volume averaging plan and the "definition" of significant deterioration under this plan tends to be much more arbitrary.

Furthermore, although the average volumetric concentration is easily calculated for a single source, the additive effect of multiple sources is much more dificult to compute. Since this plan contains no inherent advantages, yet is technically more difficult to implement than a ground-level air quality increment plan, a volume averaging plan was not used.

In addition to the conceptual difficulties with a volume averaging plan, the specific increments proposed by the Sierra Club would impose severe growth restrictions, especially on energy-related facilities.[6] The Sierra Club has presented no rationale for these specific increments.

2. Emission limitation plan

A typical emission limitation plan was described in EPA's initial proposal of July 16, 1973 (38 FR 18986 at 18991). This plan would have limited total emissions of TSP and SO_2 over a relatively large area and indirectly prevented the significant deterioration of air quality.

Basically, this plan focuses on total atmospheric loading, and as such has many of the same advantages and disadvantages as discussed for the volume averaging plan. It has a significant advantage in terms of technical simplicity over an air quality increment plan, in that emission data are easier to acquire and more reliable than estimates of air quality computed using atmospheric simulation models. However, its principal disadvantage is the lack of consistency between emissions and air quality, particularly on a nationwide basis. As discussed above, a plan which focuses on ground-level air quality, in accordance with traditional air quality management practice, is considered preferable to an average atmospheric burden plan. In addition, the averaging of emissions over a large region could permit the creation of small areas of substantial air quality deterioration. This might be inconsistent with the court's order to prevent "significant deterioration in any portion of any state."

The growth and development impacts of this plan were analyzed in several studies[7,8,9,10] and are summarized in a separate report.[11] These studies indicate that economic growth would be restricted in a number of instances and that these restrictions would be most severe for coal-fired power plants.

3. Emission charge plan

The general reasoning behind such a plan is that secondary NAAQS comprise adequate upper limits on pollutant concentrations,

but air quality superior to those limits is desirable. The emission charge would provide a continuous incentive for sources to seek and apply emission controls to minimize their emission charges. The collective effect of these individual cost minimizations would be to maintain air quality at levels superior to NAAQS in most areas. The level of air quality maintained would be a function of the emission charge rate, the development potential of the area, and the state-of-the-art of emission control.

The major advantages of this plan are that the cost of emitting would be "internalized: i.e., it would be taken into consideration in the normal economic appraisal of plant design and location alternatives. Sources would have numerous options as to control method, cost, and degree of control from which to make the optimum choice. The state-of-the-art of emission control would be continuously advanced. Finally, the means of enforcement would be charge collection which is relatively easily administered.

Unfortunately, several problems attend such a plan. In view of the requirement that "significant deterioration of air quality is to be prevented by the emission charge, some relationship between the charge rate and the resultant air quality must be found. Such a relationship is not presently available. Even if this relationship were available, the emission charge rate would have to vary from place to place to offset the variation in developmental

potential offered by different land areas and the variable capacity of the air to disperse waste under different meteorological and topographical conditions. Also, there is a question as to whether the Clean Air Act provides adequate legal authority for EPA to implement such a plan. But most important, an emission charge would not guarantee that significant deterioration could not take place in some portions of some states. Consequently, the emission charge, while possessing some desirable attributes, does not appear to be a practical means of preventing significant deterioration of air quality, especially on a nationwide basis.

4. Per capita emission plan (NRDC plan)

The Natural Resources Defense Council (NRDC) proposed a per capita emission plan. Under this plan the total emissions in clean areas, plus a five percent increase, would be divided by the total population in clean areas to arrive at the allowed per capita emissions. The total emissions allowed in any area would then be calculated as (the population in the area) times (the per capita emission rate). The primary advantages claimed for this proposal are the emphasis on emissions rather than air quality, and the relationship between the level of emissions and the population served. The latter advantage cited by NRDC would

in many cases represent a major disadvantage. Because part of the motivation to prevent significant deterioration is concern for currently unquantified but suspected low level effects, it does not seem reasonable to force new polluting development to locate in areas of high population. This result would add new pollution in areas where air quality levels are already relatively high and would result in many more people being exposed to the added pollutants than if sources were located in less populated areas.

This plan would tend to prevent development of currently needed natural resources such as low sulfur coal and oil shale which are located in areas of very low population. In addition, the location of many other facilities such as smelters, paper mills, phosphate rock processing, and oil shale retorting are determined by the location of natural resources, not the population served. Under the per capita emission plan it is unlikely that facilities such as these could be built.

5. Percent increase above existing air quality level

This approach would limit deterioration to fixed percentages above existing air quality levels. The problem with the plan is in the difficulty of defining "existing" air quality. Even with no change in man-made

emissions, air quality levels in "clean" areas can vary substantially from day to day, year to year due to changes in natural emissions and variations in meteorological conditions.*[12] A further problem with this plan is that air quality monitoring is presently concentrated in heavily polluted urban areas, which constitute only a small portion of the total area of the country.[13] In the relatively clean rural areas which are principally affected by the significant deterioration regulations, there is very little monitoring being done. Although atmospheric diffusion modeling could be used to estimate existing air quality levels, the difficulty in quantifying natural sources of particulate matter would make the results quite questionable. Also, models for estimating existing concentrations of reactive pollutants (nitrogen dioxide and photochemical oxidants/hydrocarbons) are not available as discussed below. In summary, accurate definition of

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* "For example, Cape Hatteras, North Carolina, showed a yearly average of (of TSP) 58 $\mu g/m^3$ in 1968 and 110 $\mu g/m^3$ in 1972. The station in the Black Hills National Forest, South Dakota, had an annual average of 10 $\mu g/m^3$ in 1968 and 37 $\mu g/m^3$ in 1964. The range of 24-hour averages for a single station is often from a few micrograms per cubic meter to over 150 $\mu g/m^3$. For example, in Rio Arriba County, New Mexico, the lowest reading was 9 $\mu g/m^3$ and the highest 257 $\mu g/m^3$ during 1964. . . . Although attempts to measure SO_2 at twenty-eight non-urban stations have been conducted over the past six years, the results of this effort forced the conclusion that it will be essentially impossible to establish any sort of baseline, nationally or area-wide, using the standard reference method. This is largely due to the insensitivity of the technique." (Reference 12 at pp. 5-6). These data also influenced EPA's dicision not to have a single inviolate deterioration increment for the whole country.

existing air quality in clean areas of the country is not available nor can such data reasonably be obtained.*

6. Local definition plan

This plan would have prevented significant deterioration by requiring local determination, on a case-by-case basis, of the significance of the air quality impact of major new sources. This plan recognized the variability between areas and called for a subjective decision-making procedure to be implemented at the local level. A major disadvantage is that the local definition plan uses what is essentially a "sliding baseline," and deterioration is always measured relative to the current air quality. Hence, there is no control over the ultimate level of deterioration, which could progress in finite increments up to the level of the secondary standards. Also, the long range impact of deterioration is not restricted to the local area. The regulations proposed on July 16, 1973, associated with this plan required public comment from within "the area significantly affected by the potential emissions".

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* The plan selected does not present these difficulties although it refers to increases above a baseline level. The increases are stated in absolute terms, not as a percentage of the baseline. Thus, the baseline may be taken as zero and subsequent air quality changes determined by modeling the air quality effects of increased or decreased emissions which were not included within the baseline.

However, it is entirely possible that the cumulative effects of sources in "growth-oriented" regions could have a significant impact on the air quality of neighboring "clean-air oriented" regions, and these neighboring regions would thereby lose control over their own environment. Although the State, rather than the local population, has final authority for the definition of significant deterioration (which tends to mitigate this concern), the impact of sources in one region on the air quality in neighboring regions remains a problem under this plan which could be especially serious in interstate situations.

7. Establishment of absolute air quality levels below the national standards.

In effect, this plan would result in more restrictive air quality "standards" which would place an absolute ceiling on air quality concentrations. However, the amount of deterioration which would be permitted under this plan would vary significantly throughout the country depending on existing air quality levels. In very clean areas, a substantial amount of deterioration would be permitted, while in areas that presently exceed the selected "standard", absolutely no deterioration would be permitted. Therefore, this plan could be very inequitable, especially when applied on a nationwide basis.

IV. Selection of air quality increments

The Class I increments represent extremely stringent deterioration criteria, and application of these increments would prohibit the introduction of even one small fossil fuel fired power plant or municipal incinerator[14] unless existing emissions are reduced. Strong incentives therefore exist in Class I areas for improved emission control technology to reduce existing emissions and for introduction only of low-pollution development. Although Class I could be applied to a semi-urban or urban area in which it was desired to inhibit further development, it is anticipated that Class I would normally be applied to those ultra-clean areas such as national and state forests and parks, and other recreational areas in which it is desired to prevent essentially any deterioration of air quality.

The Class II increments were established to permit what, in the Administrator's judgment, constitutes moderate, well controlled growth. Large point sources, aggregation of several moderately-sized sources, and large-scale general growth would be permitted only in Class III areas.

For example, the power plant size that normally would be permitted at a single location within a Class II area is approximately 1000 MW.[15] Assuming that such a source used up 90% of the allowable increment in a Class II area, a similar source could not be located within 25 miles of the first plant.[16] Similarly, typical coal gasification plants, oil shale processing facilities, and petroleum refineries would not be expected individually to exceed the Class II increments in most areas. However, the Class II increments would prevent the aggregation of such sources within close proximity of each other. It should be noted that the foregoing statements are generalizations, since the impact of the Class II increments with respect to the source size permitted and the distance which must be maintained between major sources is highly dependent on the meteorology, topography, and stack heights applicable in each specific situation.

Comments were specifically requested in the August 27, 1974, proposal as to whether the Class II increment should be doubled. Power companies generally supported such a change, while other comments from the industrial sector indicated that the increments were adequate for well-controlled growth. Power companies indicated that many

new plants would be much larger than those which would be allowed in a Class II area (approximately 1000 megawatts), and that the Class II increment ought to accomodate such development. None of the comments presented any reasons for permitting such development in a Class II rather than a Class III area, except that the initial designation of all areas will be Class II. The Administrator continues to feel that a Class II increment should be compatible with moderate, well-controlled development in a nationwide context,[17] and that large-scale development should be permitted only in conjunction with a consicious decision to redesignate the area as Class III.

V. Pollutants covered by the regulation

Many comments have criticized the omission of carbon monoxide (CO), nitrogen dioxide (NO_2), hydrocarbons (HC), and photochemical oxidants (Ox) from the regulations. As indicated on July 16, 1973, and August 27, 1974, and in previous actions involving indirect source review (38 FR 29893 at 29894, 39 FR 7270 at 7272, and 39 FR 25292 at 25295), existing mathematical modeling procedures are not adequate to determine the impact, prior to construction, of individual sources on air quality

concentrations of reactive pollutants (NO_2 and Ox). These pollutants are formed in a complex atmospheric reaction which is dependent on a number of variables such as temperature, humidity, solar intensity, concentration and chemical reactivity of hydrocarbon precursors, and concentration of nitrogen oxides. Diffusion/photochemical models are still in the research stage and generally have not focused on the impact of individual sources. Therefore, the only presently available technique for relating emissions to air quality for these pollutants is the area-wide proportional model used for demonstrating the adequacy of control strategies.[12]

The proportional model assumes that air quality is proportional to emissions in the area. To determine how much emissions can be increased without increasing ambient air quality levels by more than a given increment, it is necessary to know at some point in time both the air quality and the emission levels in the area involved. The permissible emission increase is then equal to the allowable percentage increase in air quality levels.

As indicated above, the air quality data which must be available in order to use the proportional model are

very limited in presently clean areas (even more so than for TSP and SO_2). Furthermore, the lower the levels are of identified emissions or air quality, the less accurate the results that can be obtained from using the proportional model. In very clean areas with virtually no baseline emissions, the addition of a major source may increase emissions in the area by several orders of magnitude. Increasing available air quality data (assuming that such data are available) by several orders of magnitude would yeild highly questionable results, for several reasons. First, the accuracy of air quality data at low ambient levels is very poor. Multiplying very small air quality levels by several orders of magnitude multiplies the substantial initial range of error by a similar amount. Secondly, if air quality is presently below the detection limit of the measurement method, no prediction can be made (i.e., the emission increase would be multiplied by zero). Finally, there are natural sources of hydrocarbons which contribute to the photochemical reaction; however, the magnitude of these emissions cannot be adequately quantified at this time. Thus, identified emission levels in "clean" areas may be far less than

actual emission levels contributing to the air quality in the area. In contrast, the proportional model is adequate for control strategy development in urban areas where measured air quality data are available and the aggregate impact of many identified sources is being anlayzed. However, it is inappropriate for analyzing the incremental impact of individual new sources, particularly in "clean" areas.

Although CO is stable and emissions can be adequately related to air quality, CO is almost exclusively emitted by mobile sources (85% in 1970). Therefore, in order to treat CO in the same manner as TSP or SO_2, significant deterioration considerations would need to be incorporated into EPA's indirect source review procedure (39 FR 25292). However, Congress has recently expressed reservations about the indirect source review program by prohibiting EPA from using fiscal year 1975 funds for any program which could restrict parking facilities. Even if the question of indirect source review is favorably resolved, only CO can be adequately dealt with through this program.

Other factors which mitigate against the need to specifically include the automotive pollutants under these

regulations are as follows:

1. The Federal Motor Vehicle Control Program will result in sizeable reductions in emissions on a nationwide basis for CO and HC for many years into the future. This will be true even if the auto emission standards are frozen for 5 years at the level presently required in California, as the Administrator has proposed in his recommended changes to the Clean Air Act. That is, the nationwide emissions of CO and HC will be continually reduced through the mid-1980's, and the effect of any suspension of the present statutory standards would only reduce the rate at which emissions are decreased.[18]

2. A basic requirement for sources subject to the regulations is the application of Best Available Control Technology (BACT). The Federal Motor Vehicle Control Program accomplishes this for individual motor vehicles. New source performance standards (NSPS) have already been established under Part 60 of this chapter for many of the source categories subject to the regulation. Where practicable, emission limitations for CO, NO_x, and HC have been promulgated for those sources presently subject to Part 60. Although some of the source categories are not yet included

in Part 60, either (1) those that are not covered are not significant emitters of CO, NO_x, or HC; or (2) control technology for these pollutants is unavailable or an emission limitation is impractical (e.g. since HC emissions from coke ovens cannot be adequately measured, a numerical HC emission limitation is not feasible for this type of source).

3. At ambient air quality levels for CO approaching the national standards, the only known or suspected effects are those relating to human health. At such levels, there are no known effects on plants, animals, materials, visibility, or other non-health related effects. With respect to the health effects of CO, the National Academy of Sciences has recently concluded that "(o)n the basis of data available at this time, we cannot identify any population group that would be adversely affected by carbon monoxide exposure from ambient air if statutory standards are met".[19]

An additional step which could be taken to minimize emissions of CO, NO_x, and HC appears to be in the area of minimizing vehicle miles of travel (VMT). Plans for reducing VMT and minimizing future VMT growth have been developed as part of the Transportation Control Plans (TCP) submitted by the States or promulgated by EPA. Since the TCPs focus on major metropolitan areas, the flexibility available in designing these plans would be more limited when applied

to rural and outlying areas. It is clear, however, that comprehensive transporation planning offers an appropriate mechanism for minimizing VMT growth in such areas. It is not clear, however, how EPA might become involved in comprehensive transportation planning throughout the country under these regulations, although states may wish to consider such an approach when developing their own plans to prevent significant deterioration. States, of course, are not precluded from including other more comprehensive measures for dealing with HC, CO, and NO_x in their own plans.

Some difficult additional questions arise as to how this concept of VMT minimization could be incorporated into these significant deterioration regulations. Would the addition of a VMT increment, similar to the air quality increment approach used in these regulations, be appropriate? How would it be enforced? The Administrator has solicited additional comments on this issue and may modify the regulation at a later date if workable procedures in this area can be developed.

VI. Sources subject to review

The 18 sources categories which are covered by the regulation, except for fuel conversion plants, are the

largest present emitters of SO_2 and TSP on a nationwide basis.[20] Fuel conversion plants (coal gasification and liquefication, oil shale processing, etc.) were included due to their significant growth potential, particularly in presently clean areas. The air quality impact of average-size sources subject to review is analyzed in references 10 and 16. The air quality impact of sources not included in the 18 categories is taken into account, since the total air quality deterioration above the baseline is taken into account when an application to construct a new source in one of the 18 categories is reviewed.

Although the preconstruction review of smaller sources is not so critical during the initial phase of this program and such review would contribute greatly to the difficulty of initial implementation of the program, inclusion will become more important as the air quality approaches the

allowable increment. Therefore, the Agency is considering the addition of sources to the list, perhaps using the addition of sources subject to the new source performance standards under 40 CFR Part 60 as a way of "phasing in" additional sources to be covered by these regulations.

VII. Air Quality Monitoring Requirements

The July 16, 1973, proposals included a provision requiring that source owners must install air quality monitoring instruments to assess the impact of their facility. This provision was not included in the final regulations. The accuracy of the measurement methods in relation to the air quality increments and the year to year variability of air quality data severely limits the usefulness of the data collected.[12] In addition, the use of air quality monitoring to determine whether the applicable increments are being maintained assumes that the baseline air quality from which deterioration is measured (i.e., 1974 air quality) is accurately known. As indicated in Section III.5 above, such baseline data are not generally available. Baseline air quality data are not needed in order to implement the regulations, since significant deterioration is defined in terms of air quality increments rather than absolute air quality levels.

In actual practice, it is anticipated that assessment of the available increment will normally be accomplished through an accounting procedure whereby atmospheric modeling[21,22] of individual sources will be used to keep track of the available

(or "unused") increment as sources and emission are increased or decreased. After a source has been given permission to construct based upon a diffusion model, it would be very inequitable to require the source to shut down because the EPA or State approved model was inaccurate. Therefore, air quality data are not needed either to define an air quality baseline or to assess the amount of deterioration that has occurred.

VIII. Impact of the regulations on general growth and development

In general, the impact analyses that have been performed focus on the Class II areas, since the Class I increments are intended to prohibit all significant growth and no new restrictions are created by the Class III "increments." Reference 9 is a summary of the impacts of the various options proposed on July 16, 1973, and is based on the date contained in References 7, 8, 9, and 10. Alternative I discussed in these references (the single air quality increment plan) is virtually identical to the final Class II increments. Additional information on this issue, including a discussion of whether the regulations might inhibit development of new communities and increase urban sprawl and congestion, is contained in Reference 23, pp. 8-13.

IX. Impact on power generation and new energy sources

Reference 15 provides the basis for concluding that a 1000 MW power plant will generally not exceed the Class II

increments. This reference also provides the basis for increasing the Class II increment for SO_2 from 300 ug/m^3, maximum 3-hour average, to 700 ug/m^3.

A study was done to determine whether the size of a power plant that could be constructed in a Class II area would be affected by the use of flue gas scrubbers to meet the new source performance standards (NSPS). It was concluded that the ground level concentration resulting from a cold scrubber plume would be increased by 20-80%, depending on the meteorological conditions assumed, as compared to an unscrubbed, and therefore warmer, plume. However, for a hypothetical 1,000 MW power plant meeting NSPS with a scrubber and assuming no plume reheat, the predicted concentrations for specific meteorological conditions in the upper Ohio valley were still well within the Class II increments.

Reference 16 discusses the long-range transport of pollutants, particularly in relation to the violation of the Class I increments by a power plant in an adjacent Class II area. It is apparent that a 1000 MW power plant can endanger the Class I increment for SO_2 at distances of 50-60 miles downwind, depending on the persistence of poor meteorological conditions.

Reference 23, pp. 21-23 summarizes the impact that the Class II increments (equivalent to the original Option #1) would have on the development of new sources of energy.

X. Interstate boundary conflicts

Calculations have shown that because of the small air quality increments specified for Class I areas, these levels can be violated by a source located many miles inside an adjacent Class II or III area. For example, a power plant which just meets the Class II increment for SO_2 could under some conditions violate the Class I increment for SO_2 60 or miles away. Under the significant deterioration regulations, a source would not be allowed to construct if it would violate an air quality increment either in the area where the source is to be located or in any neighboring area in the State. Therefore, wherever a Class I area adjoins a Class II or III area, the potential growth restrictions, especially for power plant development, extends well beyond the Class I boundaries into the adjacent areas. A similar situation exists, to a greater or lesser degree, wherever areas of different classification adjoin each other. Therefore, the area with the less restrictive classification should include an additional area at the periphery where it is clearly recognized that development will be somewhat restricted due to the adjacent "cleaner" area. As a result, a Class I redesignation could be fairly limited in size, yet the adjoining Class II or Class III areas would need to cover a substantial area in order to fully utilize the Class II or III increment. Again, it should be clear that the Class II or III increment could only be fully utilized toward the center of the area and that

at the periphery, permissible siting of new sources will be dictated by the adjoining Class I area rather than the Class II or III increment.

The distance a large source would need to be located away from a Class I boundary is more dependent on the meteorological conditions in the area than the size of the source. Where very long pollutant travel times from the source to the receptor are involved, the assumptions concerning the persistence of wind direction and atmospheric stability are critical. At some point, it can be assumed that a receptor will be virtually unaffected by a source, regardless of the source strength, since the critical meteorological conditions would not be expected to persist long enough to move the pollutants from source to receptor for any significant period of time. This distance is, of course, dependent on local meterological conditions, but for most areas the maximum distance would be 60 to 100 miles.

The regulations include provisions for dealing with problems created when a State or Indian Governing Body wishes to designate one or more of its areas in such a way that it will have a negative impact on other States or Indian Reservations. These regulations provide that a State or Indian Governing Body must take into account the effect of proposed redesignations on other States, Indian Reservations, and regional and national interests. Where no State or Indian Governing Body protests the redesignation of another State or

Indian Reservation, the Administrator will only review the redesignation to determine whether it is arbitrary and capricious. However, where a State or Indian Governing Body protests a redesignation to the State proposing the redesignation and to the Administrator, the Administrator will take an expanded role of review in which he will balance the competing interests involved.

XI. Best available control technology

In the original proposal, two alternative definitions of Best Available Control Technology (BACT) were discussed. Under both alternatives, a case-by-case review to determine BACT was required of each source for which new source performance standards were not applicable. Under the first alternative, the attainment of new source performance standards (NSPS) promulgated pursuant to section 111 of the Act would be equivalent to application of BACT for all sources except for sulfur dioxide emission from fossil fuel-fired steam electric power plants: for these plants a case-by-case review was required to determine if emissions could be reduced to below NSPS. Under the second alternative, fossil fuel-fired steam electric power plants were treated like all other sources for which NSPS are applicable.

In the final regulations, the second alternative is incorporated: power plants would not be subjected to the special BACT review because requiring such a review would be inconsistent with the NSPS. Further, the requirement for application of BACT for control of hydrocarbons, oxides of

nitrogen, and carbon monoxide has also been deleted because this requirement was inconsistent with the restriction of these regulations to particulate matter and sulfur dioxide. As discussed in Section V, BACT for these pollutants is already required, to the extent presently feasible, for the 18 source types subject to review.

XII. Initial classification and criteria for reclassification

There was considerable divergence of opinion over the initial classification of all areas. Industrial groups generally supported an initial designation of Class III so as to minimize disruption of projects scheduled to commerce construction in the near future. Environmental groups supported an initial designation of Class I, fearing that a Class II or III designation would permit air quality deterioration of some clean areas before States could act to redesignate areas to a more restrictive classification. The Administrator continues to feel that an initial Class II designation represents the most reasonable compromise between these widely differing positions. Also, since the regulations apply only to sources which commence construction after June 1, 1975, the Administrator feels that this deferral should reduce disruption to the industrial sector while permitting States sufficient time to consider reclassifying any area either to Class I or III before requests for approval must be acted upon.

In order that the Administrator will have an adequate basis for determining whether an application to redesignate

an area should be approved or disapproved, the regulations require that the necessary information be a part of the hearing record on the proposed designation. Specifically, the hearing record must show that the social, environmental, and economic effects of the proposed redesignation have been evaluated for the area being reclassified as well as for adjacent areas and that regional and national interests have been considered. EPA will disapprove a proposed redesignation if the State has not properly examined the effects of the redesignation or has arbitrarily and capriciously disregarded such effects.

It is not anticipated that there will be large scale redesignations to Class III, for several reasons. First, the initial Class II increment will accommodate most moderate, well controlled development, as discussed above. Secondly since a State must fully discuss the reasons for a proposed redesignation at a public hearing, a State that proposes a redesignation to Class III without showing a definite need for such redesignation would likely meet with considerable resistence at the public hearing. Finally, should a State submit such a proposed redesignation without adequate justification, EPA would disapprove the proposal as having arbitrarily and capriciously disregarded the environmental effects of the redesignation.

XIII. Effective date for source review and determination of significant deterioration

The December 5, regulations establish the air quality concentration during 1974 as the baseline for determining whether significant deterioration has occurred. The Sierra Club has contended that significant deterioration should be measured from May 30, 1972, the date that the implementation plans were to be approved or disapproved by the Administrator. Because of the far-reaching implications of these regulations on growth and development, it is important that the allowable deterioration increments be wisely used and that the allocation of limited air resources be planned and managed with full consideration of the impact on future growth and development. To make the baseline for measuring deterioration retroactive to May 1972 would require that the effect of sources commencing construction since that date be counted against the allowable increment. Yet the States, in granting such sources permission to construct, had no opportunity to consider the full implications of their decision (such implications being only now available). Furthermore, to subject sources constructed, or which started construction, during the period from May 1972 to June 1975 to the significant deterioration requirements (which could result in closing those sources violating the allowable increments) would, in the Administrator's judgment, be grossly unfair.

The Sierra Club has suggested that as a minimum, such sources be required to install BACT on a retrofit basis.

There would be relatively little benefit to be gained by such a requirement, since the overwhelming majority of emissions from sources subject to significant deterioration review have been subject to new source performance standards since August 1971.[12] New source performance standards have been in effect for the following sources commencing construction after August 17, 1971: fossil fuel fired steam electric generating plants (by far the most important source category both in terms of the number of new plants constructed and in terms of emissions of both particulate matter and SO_2), incinerators, portland cement plants, and sulfuric acid plants. NSPS have been applicable since June 11, 1973, to petroleum refinery catalytic regenerators and process gas combustion and steel mill basic oxygen furnaces.

For those sources commencing construction since May 1972 and which are not subject to NSPS, emission control equipment has, in most cases, been incorporated as part of the original design. Although such equipment may be quite efficient and may represent a significant investment, it may not be equivalent to BACT. The retroactive application of BACT could then result in scrapping virtually brand new control equipment in order to obtain only modest additional emission reduction. In the Administrator's judgment, this result is both unwise and inequitable.

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* 6. "Sierra Club Proposal," November 8, 1973.

7. "The Impact of Proposed Non-Degradation Regulations on Economic Growth," Volumes 1 and 2, Harbridge House, Inc., November 1973.

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23. "Findings of Task Force on Significant Deterioration," R. G. Rhoads, December 20, 1973.

24. "The Largest Annual Average, Maximum 24-hour and Minimum 3-hour Concentrations of Sulfur Dioxide Produced Per Year by a Modern 1000-MW Electric Power Plant Meeting the New Source Performance Standards for Sulfur Dioxide Emissions," Enviroplan, Inc., 1974.

* References with an asterisk are reprinted as attachments to this document. The other references, which are too lengthy to reprint as part of this document, are available for public inspection at the EPA Freedom of Information Center, 401 M. Street, S.W., Washington, D.C., 20460.

Reference 6

SIERRA CLUB PROPOSAL 8 Nov 1973

The plan proposed by the Sierra Club to prevent significant deterioration of air quality is based on a volume averaging or mixing zone type of approach. (Attachment 1 is the testimony given by Mr. L. Moss at Washington) Under this plan the pollutant concentrations would be limited to certain specified incremental levels in a spheroid surrounding the point source. Figure 1 depicts the situation. Table 1 shows the allowed increases in concentration allowed. In addition to the incremental increases in the volume around the sphere, they also recommend that the total emissions over an AQCR be limited to increases of 1 Ton/yr/mile^2 for all criteria pollutants except CO where 20 Ton/yr/mile^2 would be allowed.

Allowed Emissions Under the Sierra Club Proposal

The actual allowed emissions under this type of plan will vary from location to location but if some simplyfying assumptions are made, it is possible to compute the emissions allowed under the increment. (Attachment 2 shows information supplied by Dr. M. Williams on behalf of the Sierra Club.) For purposes of their discussion of potential impact the Sierra Club assumed:

1. an annual wind speed of 6 m/sec (13.2 m/hr) and
2. a 250 m stack height.

They felt that both of these assumptions were reasonable for power plants in the southwest. While this is true, it appears that the annual wind speed may be too high for many areas and the "allowed development" less.

Following the Sierra Club assumptions the maximum allowed emission rate is 5.35 T/day or 1950 tons/year. This is limited by the annual increment of 4 ug/m^3.

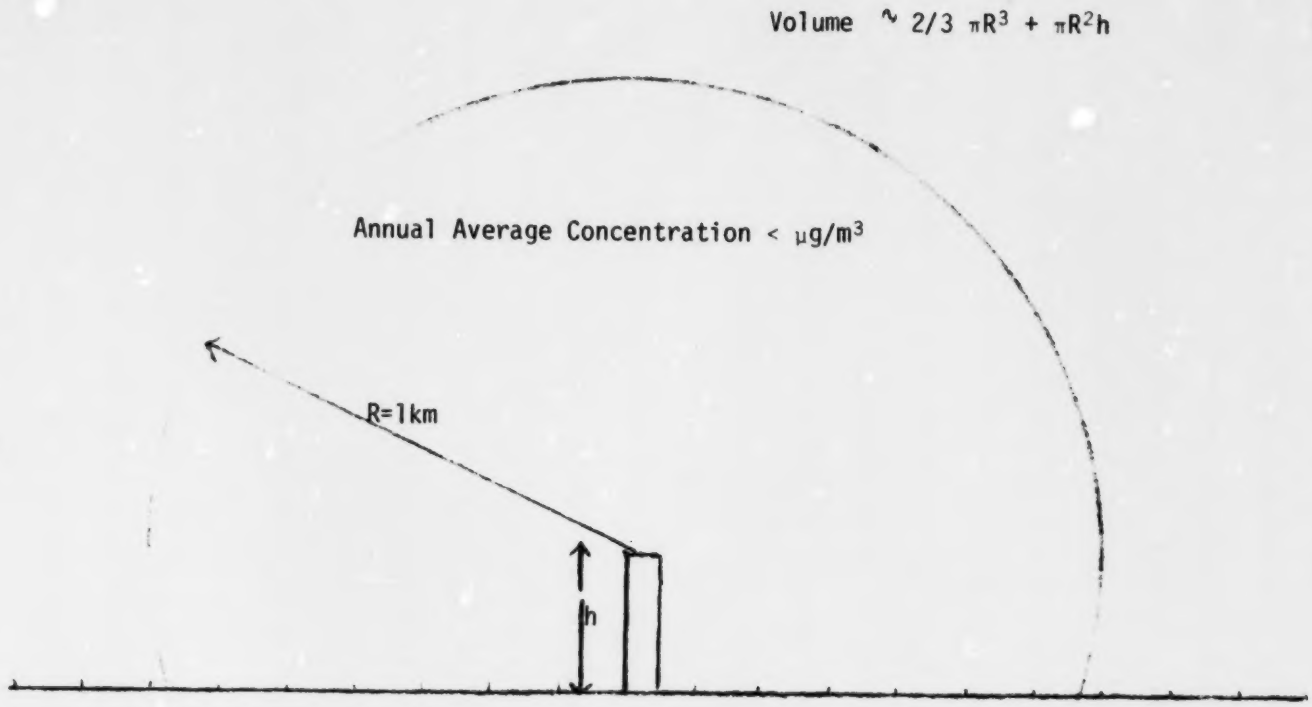

Figure 1

Representation of Volume
Averaging Concept

TABLE 1

INCREASES IN POLLUTANT CONCENTRATION*
ALLOWED UNDER SIERRA CLUB PROPOSAL

	ALLOWED INCREASE (ug/M^3) FOR		
POLLUTANT	1 HR	24 HR	ANNUAL
TSP	100	50	4
SO_2	100	50	4
HC	100	50	4
NO_x	100	50	4
CO	2000	1000	80

* All concentrations are averaged over a one kilometer sphere around the source

Required Levels of Control Technology

In their presentations at public hearings and in written comments, the Sierra Club indicated that a large amount of industrial development would be allowed. (Attachment 3 shows development the Sierra Club claims is allowed. Attachment 4 is material submitted by Dr. M. Williams to support these assumptions.) Their assumptions on control technology were reviewed by Control Technology, OAWP which stated, "For the most part the Sierra Club has assumed the best of all possible situations--an abundance of natural gas, raw materials with low pollution potential, and an ability to develop any level of control technology. Many of these assumptions are unrealistic particularly in view of the fuel shortage. Costs of control have received no consideration at all." Table 2 shows some of the plant types analyzed under this procedure, the Sierra Club assumptions on control technology and comments of EPA engineers.

The impact on coal fired power plants and petroleum refineries is especially severe. For example, if NSPS were applied to a coal fired power plant the maximum plant size would be 52.8 MW. If state of the art stack gas cleaning (80-85% sufficient) were combined with 0.5% Western coal, the maximum allowable plant size would be 200 MW. The Sierra Club claims that 97% SO_2 removal on 0.5% western coal is available and as such the sulfur dioxide limitation would allow a 2200 MW power plant to be built.

A similar situation exists if the oxides of nitrogen are considered. A plant which meets NSPS (0.7 lbs $NO_x/10^6$ BTU) would be limited in size to about 94 MW. If NO_x emissions are limited to 0.45 lbs/10^6 BTU (a level possibly attainable) the plant would be limited to about 150 MW. If NO_x

TABLE 2

PLANT TYPES IMPACTED BY SIERRA CLUB PROPOSAL

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Plant Types	Allowed Size (Sierra Club)	Assumptions	Comments
1. Power Plant (coal fired)			
a. If only TSP, SO_2 considered	2200 MW	1. 0.5% S coal, 2. 2.98% SO_2 removed	1. 0.5% S coal not nationally available, 2.98% S control represents a 10 fold decrease in emissions below state of art.
b. If TSP, SO_2, NO_x considered[2]	200-220 MW	1. 0.5% S coal, 2. 80-85% SO_2 removed, 3. 0.3 lbs NO_x^2/10 BTU	1. Absolute limit of present control technology of all pollutants if all systems operate perfectly and low sulfur coal is available. 2. Average size of new coal fired power plants is expected to be 620 MW.
2. Refinery	65-100,000 bbl/day	1. 0.7% S crude, 2. natural gas to heat boilers, 3. NO_x control on boilers[3]	1. Low sulfur oil not always available, 2. Avg. Expansion of existing plant = 150,000 bbl/day, 3. Natural gas not available, 4. NO_x controls not demonstrated, 5. [x]Level of control possibly feasible but a large expense.
3. Copper Smelter			
a. Roaster	22T/Day	1. 90% SO_2 removal	1. Control Assumptions Reasonable.
b. Flash	88T/Day		
4. Coal Gasification	175 MCF/Day	1. Product gas firing boilers	1. Normal expected design size for plants = 250 MCF/Day, 2. Expected design uses coal to fire boilers, 3. NO_x control as stated has not been attained, 4. SO_2 emission levels much lower than[2] those slained by industry.

if further reduced to 0.3 lbs/10^6 BTU (a level possibly attainable by one manufacturer) the maximum power plant size would be 220 MW.

Thus the maximum coal fired power plant which could possibly be constructed under the Sierra Club proposal using low-sulfur coal, stack gas cleaning and ideal furnace design for NO_x control is 200-220 MW. In areas where very low sulfur coal is not available, the maximum plant size would be less than 100 MW. Current planning of coal fired power plants estimates that the average plant size is to be about 600 MW.

Economic Impact of Sierra Club Proposal

It is extremely difficult to estimate the economic impact of the Sierra Club proposal, because the actual allowed emission rate will vary from location to location. However, it appears that many industries and some light development would be able to be undertaken without a substantial increase in cost over what now is required.

The Sierra Club proposal does appear to have a very substantial impact on the power and oil industries. If, as described previously, the maximum coal fired power plant size is limited to 220 MW, constraining coal fired plants to these levels would result in either a rapidly decreasing reliance on coal and a switch to nuclear power or very large numbers of very small power plants at a much higher cost. In addition to the higher capital cost, the resulting increases in distribution and coal hauling facilities would also result in considerably higher costs.

The restrictions applied to the size of new or expanded oil refineries would also impose a substantial economic burden. It would result in greater numbers of small refineries with resulting higher transportation and

distribution costs. In addition, to build even these small refineries would require the consumption of scarce natural gas and thus divert this from other uses.

Severe limitations are also placed on conventional copper smelters. Maximum allowed size under the Sierra Club proposal is 88 T/day or 32,000 T/yr; average design size for smelters is 100,000 T/yr. The hydrometalurgical processes are not available for all types of copper ores.

Technical Difficulties in Implementing Sierra Club Proposal

One point emphasized in the Sierra Club proposal was that areas where existing sources could be controlled there would be much greater room for the expansion of new industrial processes. While this is probably true, to some degree, there are two major technical problems associated with carrying out the type of proposal suggested by the Sierra Club. The first of these involves the monitoring of pollutants at the low levels and in the volume suggested by the Sierra Club. Current instrumentation for sulfur dioxide, nitrogen oxides, and hydrocarbons operating at stationary ground level monitoring stations is not sufficiently accurate to distinguish the proposed Sierra Club increments from random raise associated with the day-to-day operation of the instrument. To adequately handle the type of monitoring required by the Sierra Club would require that monitoring be done from instrumented helicopters or aircraft. It is not presently possible to perform this type of analysis.

Monitoring could possibly be carried out by remote sensing devices such as the lider but presently these also do not have sufficient accuracy.

The second major difficulty with the Sierra Club proposal lies with the ability to do the type of modeling required. While as the Sierra Club states the modeling required under their proposal for a single isolated source is relatively simple, the extension of modeling to multiple sources areas becomes extremely difficult. The current gaussion diffusion models were developed to predict concentrations at a point on the ground or in space. They are presently accurate to within a factor of two half the time. The extension of these models to integrate the concentration in a spheroid some distance removed from the source does not presently appear reasonable. From an enforcement viewpoint the capability for using reductions from existing sources probably only exists in the very near vicinity of large isolated sources which can reduce emissions considerably.

Administrative Difficulties in Implementing Sierra Club Proposal

The volume average concept espoused by the Sierra Club is an entirely different process of air quality management than that currently ongoing for the attainment and maintenance of NAAQS. To handle both the attainment and maintenance of NAAQS by means of ground levels concentrations and to prevent significant deterioration via the volume average techniques would appear to drastically compound the administrative burden.

In addition, the source size selected by the Sierra Club as requiring review would impose a greater burden on regulatory agencies. The size selected was 1 Ton/yr for all pollutants except CO and 20 Tons/yr for CO. This size would include all commercial and industrial facilities, developments of 50-100 homes heated with oil or 75-100 homes heated with gas plus

all highways and many streets. It is impossible to estimate the number of sources which would require review but it would be a very large increase as most state regulation call for review only if the source is greater than 100 T/yr.

Summary

The plan proposed by the Sierra Club allows for small increases in concentrations over a 1 Km sphere around the source. Their calculations show that this plan would allow sources in a clean area to emit 5.35 T/day (1950 T/yr) of any pollutant. Assumptions made by the Sierra Club in estimating the impact were beyond the state of the art for oil refineries, power plants and coke ovens. Monitoring and modeling techniques are not available which can be used to keep track of changes in baseline air quality to allow for reductions in emissions from existing sources. Plan would impose administrative burdens in using an entirely different procedure for attainment and maintenance of NAAQS and prevention of significant deterioration.

COMMENTS ON SIERRA CLUB PROPOSAL

1. Restrictions on Coal Fired Power Plants

In area where low sulfur fuel (0.5%) is available, new coal fired power plants would be restricted to 200-220MW assuming that NO_x can be held to 0.3 lbs/ 10^6 BTU(may be poosible). Where low sulfur fuel is not available plant size would be less than 100 MW. Both of these sizes are generally not economical facilities. Reasonably sized additions to existing plants may be possible. Basic thrust of the proposal seems to be that all new coal fired power plants will have to be built only near existing facilities. No consideration has been given to the cost of control.

2. Restrictions on Oil Refineries

New refineries would be limited to 65-100,000 bbl/day if all possible technology is used and no consideration is given to cost. Since current construction and mosification averages 150,000 bbl/day, the most feasible location for new refineries seems to be near sites occupied by existing refineries which can be very well controlled.

3. Monitoring Ability

Capability does not currently exist to routinly perform the monitoring needed to carry out the Sierra Club proposal. To require that this monitoring be carried out by aircraft or remote sensing devices is not presently feasible and if it be becomes feasible would be extremely expensive.

4. Modeling Ability

Capability does not exist to perform the type of volume average modeling in multiple source areas seemingly required by the Sierra Club

to the degree of accuracy the proposal would require.

5. Administrative Problems

Current state stratagies for attainment and maintenance of ambient standards requires conrol technology and plans based on ground level concentrations. The Sierra Club proposal would require a seperate procedure and the resultant monitoring, modeling etc. to be carried out for new sources. There does not seem to be any direct comparison between the two approaches and a large additional workload would likely result.

Reference 11

ECONOMIC GROWTH AND DEVELOPMENT IMPACTS OF PROPOSALS TO PREVENT SIGNIFICANT DETERIORATION OF AIR QUALITY

This paper attempts to answer some critical questions on the extent and nature of any economic growth limitations, altered development patterns, and dislocations that may result from final promulgation of three of the four proposed regulations to prevent significant deterioration of air quality. The conclusions are based upon the findings of four studies undertaken by EPA, the Department of Commerce, the Department of the Interior, and the State of New York. The extent to which the studies of selected industries and regions reflect the impact upon the nation as a whole must be viewed with caution. Projected growth, site peculiarities, changing economics, energy use, technology and modeling techniques for assessing air quality impacts could all alter the findings. We have identified these factors where they are relevant.

I. Summary of Findings

A. Alternative I: Ambient Air Quality Increment Plan

1. Regional Growth Impacts

a. The proposed increments appear adequate to allow projected economic growth in most urbanizing areas to 1980, while significant restrictions and/or altered development patterns will be experienced by 1990.

b. Dispersion of development in urban areas in order to reduce pollutant concentration could increase transportation-related emissions.

2. Isolated Industrial and Energy-Related Sources

a. Careful siting and the use of tall stacks would allow most isolated industrial development.

b. Additional costs are imposed upon a new plant if in order to comply with the air quality increment it must:

- build a taller stack
- apply stack gas scrubbing for SO_2 control
- incur transportation and land costs where associated industrial activities must be separated geographically or where it must move farther from its market.
- scale down its plant.

c. Incremental costs imposed by the air quality increments are in most cases relatively small. Incremental costs for power plants would be high where scrubbers are required on coal burning plants which meet NSPS or where power plant size must be limited substantially. Tall stacks would be a much lower cost alternative were they allowed in such situations.

d. Mining operations associated with new cement, copper, and iron and steel plants violate the proposed TSP increment in one area.

B. Alternative II: Emissions Density Plan

1. Regional Growth Impacts

a. Growth restrictions can be severe

- Dallas-Fort Worth violates the TSP increment in 6 years.
- Development is restricted in most of New York State by 1980.

b. The impact on regional growth varies widely with the size of the averaging area and the existing emission baseline. Regional inequities arise with averaging areas significantly smaller or larger than the proposed 10,000 square miles.

c. Power plants absorb a major portion of the allowable increments in growth areas, however, the restriction of accessible electric power in turn restricts industrial and commercial development. Growth restrictions can be severe in such instances.

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d. Northern Great Plains power complex would be restricted.

2. Isolated Industrial and Energy-Related Sources

a. An emission limitation plan impacts most heavily upon power plants.

b. In the absence of baseline aberrations industrial growth projected to 1980 would not be affected by the increment.

- with the exception of power plants, no new industrial sources violate the increment
- most growth is in priority I and II regions and thus is not covered by this regulation as proposed.

C. Alternative IV: Area Classification Scheme

Most of the comments pertinent to Alternative I apply to IV. However, it is difficult to evaluate Alternative IV, because we can not anticipate how states will classify regions.

1. Regional Growth Impacts

a. Maintaining some areas at Zone 1 levels while allowing reasonable and planned growth in adjacent areas appears to be feasible.

b. A significant number of exceptions to zone II increments would be required by 1990 in high growth areas.

2. Industrial and Energy-Related Sources

a. Zone 1 restricts most industrial activities in or near the zone with the exception of large (1000,000 TPY) Kraft pulp and paper mills and small, well controlled power plants (150 MW meeting NSPS).

II. Conclusions

A. A zoning plan based on air-quality increments would be most effective in both preserving clean air and accommodating planned economic growth. Following are the proposed zone definitions:

1. A very retrictive zone to maintain air quality in pristine areas.

2. An intermediate zone, similar to Alternative 1, to permit dispersed industrial development for plants of economic sizes.

3. A third zone, allowing growth up to the secondary standards to:

a. allow areas with exceptions to be planned rather than allow them to be developed piece-meal on the basis of economic pressures.

b. avoid the unmanagable and unnecessary burden of granting exceptions to all new sources locating in a planned growth area.

B. The intermediate zone should have an exception scheme which would permit the consideration of other socio-economic tradeoffs in (a) industrial plant siting or sizing (b) natural resource development (e.g., open pit mining) and (c) collocation of industries. Such exceptions should be possible without rezoning an entire area for degradation up to the secondary standards. In many cases the full increment up to secondary might not be required, or only a small portion of the zone might be affected by the source.

C. Tall stacks are the least cost option for reducing ground level concentrations.

1. Doubling stack height reduces ground concentration by about 70 percent.

2. More stringent increments would be possible for industrial sources in Zone II if tall stacks were allowed.

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3. The cost of doubling stack height (from 400 to 800 ft.) is $4MM while the cost of scrubber may be $50MM, both for a 1000 MW power plant.

4. In cases where scrubbing is not possible, the incremental cost of scaling down from 1000 MW to 300 MW plants is $123 MM (per 1000 MW of total capacity).

D. The air quality increments proposed for Zone II will generally provide an adequate margin for growth through 1980. The proposed 24-hr. particulate increment may require further analysis.

III. Methodology of Analyses

The analyses that have been used to assess the economic growth and development impacts of the three alternative significant deterioration regulations cover a wide range of new development situations. The studies are characterized by two approaches: analysis of impact in specific prototype regions, and analysis of impact on isolated new industrial and energy-related sources. Each approach is discussed below:

A. Prototype Regional Development

Prototypical regional developments were identified for study by EPA to reflect (1) trend development in a growing metropolitan areas, (2) resource-based development in a clean air area and (3) development in a rural state. The regions which were selected for study are the Greater Boston Metropolitan Area, the Four Corners Region and the State of Iowa respectively. Additional information is available on two additional regions: (a) the Dallas-Fort Worth area in a study undertaken by the Department of Commerce, and (b) New York State, in a study done by the State Department of Environmental Conservation.

1. EPA Study

The EPA Study of Boston, Four Corners, and Iowa used regional economic growth plans and projections to estimate emissions. An air quality dispersion model was employed to estimate the ambient air quality effects of projected emissions. Both air quality and emission estimates were then compared with proposed non-degradation increments to determine the extent of any potential restrictions on regional economic growth.

This study, performed under contract by Harbridge House and Environmental Research and Technology, used the following methodology:

a. Planned and projected economic growth to 1980 for each area was obtained from several sources including the Office of Business Economics, Department of Commerce, regional and state planning councils, the Battelle economic base study for the Four Corners Area, and updated industrial projections from each of the major source industries. Growth projections were derived on a county by county basis.

b. 1972 emissions inventories were obtained from EPA.

c. Emissions from new sources were estimated assuming attainment of New Source Performance Standards (NSPS). Published EPA emission factors were used. Where emission factors were unavailable, best available control technology was assumed to lead to a 99 percent reduction in particulate emissions and a 90 percent reduction in sulfur dioxide emissions. No control technology was assumed for open pit operations. Area source emissions for Boston were based on emission factors developed for the Northeastern U.S. These factors take residential and commercial heating and transportation into account.

d. Ambient air quality was projected for each region with the Air Quality Display Model (AQDM).

- Only annual increments were modelled for the Boston area. The annual average is assumed to be limiting in urban areas.

- A regional model was unavailable for Four Corners. Calibrated point source models were used to project 3-hour and annual concentrations.

e. The State of Iowa's Emission Inventory and projected growth in new emission sources was assessed. Air quality modelling was performed for new fossil-fuel power plants only, as they were the only new growth which might exceed the proposed increments.

2. Department of Commerce

A comparable methodology was used to analyze the Dallas-Fort Worth area. The Department of Commerce used the CDM model (EPA/NOAA: Climatic Diffusion Model) to project ambient air quality concentrations. Area source emission factors were developed on a county by county basis. Projected growth was assessed up to 1990.

3. New York State

The New York State analysis differed from the other two in the manner in which ambient air quality projections were made from emission estimates. No diffusion models were used. A linear relationship (or rollback model) was assumed between emissions and ambient conditions within each county. Ground concentrations from planned fossil-fuel power plants were obtained from available projections.

B. Isolated Industrial and Energy-Related Sources*

1. EPA Analysis

Sixteen major new source categories were identified in the proposed regulations as the major sources of SO_2 and TSP. However, in reality each major source category tends to be associated with geographically collocated industrial activity. An analysis was therefore performed of major source "building blocks" composed of the base industry and collocated industrial activity. In addition, new towns and industrial parks were analyzed as concentrated new components of urban growth. The methodology followed by Harbridge House in developing building blocks was as follows:

a. Principal links between the industries, their markets, and suppliers were identified using the National Input/Output Table (U.S. Department of Commerce, 1969) with appropriate updating. An investigation of each industry yielded information on location decisions and key determinants of the geographic location of related industrial activities.

b. Locations of the building blocks, with the exception of power plants, were determined nationwide by Air Quality Control Region using industrial growth projections from trade journals and CBE information. The emission contribution was then calculated for each AQCR, and the emission density was estimated both for the existing AQCR and for areas the size of the suggested 10,000 square mile area.

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*See Table I

c. Ambient air quality diffusion modelling was performed for 35 facilities of differing sizes in 10 major source categories. Generalized meteorological assumptions were used for three source categories: iron and steel, zinc, and aluminum (i.e., flat terrain and good dispersion characteristics were assumed). Seven source categories were modelled within the three regional analyses. Therefore we were able to take into account both the actual meteorological conditions reflecting the worst case at a specific site (e.g., low wind and unstable atmosphere) and any interaction with projected area sources.

2. Department of Interior Study

A study conducted for the Department of Interior by TRW examined projected emissions from new energy facilities* to determine if they would be allowed in an emission density scheme. TRW also applied generalized factors indicating the relationships between emissions and air quality for each geographic region of the country to estimate ambient air quality impacts.

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*See Table 1

TABLE I

The EPA Analysis examined the 16 industries are listed below:

- Power Plants
- Coal Cleaning Plants (Thermal Dryers)
- Kraft Pulp Mill Recovery Furnaces
- Portland Cement Plants
- Primary Zinc Smelters
- Iron and Steel Metallurgical Furnaces
- Primary Aluminum Ore Reduction Plants
- Primary Copper Smelters
- Municipal Incinerators
- Sulfuric Acid Plants
- Petroleum Refineries
- Lime Plants
- By-Product Coke Oven Batteries
- Phosphate Rock Processing Plants
- Sulfur Recovery Plants
- Carbon Black Plants

Plus:

- New Towns
- Light Industrial Parks

The Department of Interior analysis examined:

- Fossil fuel-fired power plants
- Geothermal power plants
- Oil shale processing
- Coal gasification
- Coal liquefaction
- Petroleum refining
- Superport storage facilities
- Metal processing (copper, lead, zinc, aluminum and steel)
- Mining

IV. Impact Analysis of Alternative Plans

This section is divided into three parts: a discussion of the findings from analysis of three of the four proposed alternatives. The State Determination alternative is not susceptible to analysis. The findings are divided between regional growth implications and industrial or energy-related impacts.

A. Alternative I: Air Quality Increment Plan

1. Regional Growth Impacts

a., The proposed annual SO_2 and TSP increments appear to be adequate to allow planned and projected economic growth in most urbanizing areas to 1980. Some areas would be affected, however, and the number of areas which experience limitations on growth would increase where greater use of high sulfur coal by existing plants becomes essential in place of low sulfur fuels.

- Maximum increased concentrations of SO_2 reached 5 ug/m^3 in Boston by 1980; 8 ug/m^3 in Dallas/Fort Worth by 1990--both well below the proposed increments.
- Any constraints on growth in the Boston or Dallas/Fort Worth areas will be related to restrictions imposed by secondary TSP standards and not to proposed significant deterioration levels.
- Two areas could be affected by the increments in New York State by 1980, however, the State does not find the impact on economic development to be significant: (a) the levels are only slightly above the limits, and (b) resiting of a few sources would reduce area concentrations to allowable limits. Moreover, because the New York State analysis did not utilize site-specific diffusion modelling, siting and stack heights which minimize ground concentrations were not taken into account and the numbers reflect higher concentrations than those achievable. Specifically:

-- The lower Hudson Valley, would appear to exceed the proposed increments by 1980.

i. This area exceeds the proposed SO_2 increment by approximately 3 ug/m^3 because of the contribution of new fossil-fueled power facilities brought on line by 1980. The increase could be even greater if another projected plant were located in the area.

ii. General population growth and economic development (30 percent increase in the number of households) could cause the particulate increment to be exceeded by 6 ug/m^3.

-- One additional area, the Greater Rochester Urban area, would approach the allowable SO_2 increment by 1980. (Projections range from 4 to 16 ug/m^3).

b. Many areas would exceed the proposed increments by 1990 and would experience limitations on future growth after 1990.

- Neither Dallas/Fort Worth nor Boston would appear to violate the increments by 1990.
- Five areas in New York State may exceed the TSP increment by 1990. Increments of up to 20-30 ug/m3 are possible based upon projected growth.
- Approximately nine areas in New York State violate the SO_2 increment by 1990.
- Power plant siting and control technology is especially critical if all reasonable growth is to be accommodated in high growth areas. Restriction of accessible electric power, which absorbs a major portion of the allowable increment, in turn restricts industrial and commerical development.

2. Industrial and Energy-Related Sources

a. Careful siting and the use of taller than traditional stacks would allow most new industrial energy development.

- The impact of the air quality increment on allowable plant size is highly dependent upon stack height. As stack height is doubled, ground concentration of pollutant is reduced by 70 percent (see Exhibit I).

• With traditional stack heights, the proposed increments for Alternative I would be violated by: 1000 MW power plants, large copper smelters, zinc smelters, cement plants, and iron and steel mills. (3 hour SO_x and annual TSP standards)

• If taller stacks are used (2 times traditional heights, see Exhibit I), copper, cement, and iron and steel building blocks still violate the TSP increments because of associated mining operations. In each case the plant itself causes no violation but would have to locate some small distance from the mine. Incremental transportation costs have not been assessed.

• It may be possible to reduce mine emissions below the increment in humid areas by wetting the site. However, in arid areas there is no technology for reducing mine emissions, and a violation of the TSP increment would result.

• The analysis is also dependent upon dispersion model assumptions regarding meteorology and topography. A plant located under poor dispersion conditions could cause ground concentrations two to four times greater than an identical plant located under the favorable dispersion conditions assumed in the modelling effort. Thus, a fixed deterioration increment could be considerably more constraining on plant size in areas with poor dispersion characteristics.

b. The assumptions on fuel utilization are important in drawing conclusions on the constraints imposed by the proposed ambient levels. The TRW analysis indicated that with the use of tall stacks (i.e., 800 feet for power plants):

> "- Power plants burning 3 percent sulfur coal with wet scrubbing technology would be limited in size to about 1000 MW in Appalachia and perhaps 1400 MW in the Rockies; 1500 MW plants could be built in all other areas."

"- Power plants burning 0.7 percent sulfur coal without wet scrubbing technology would be limited in size to about 800 MW in Appalachia and about 1200 MW in Rockies; 1500 MW plants could be built in all other areas."

"- Power plants burning 1.5 percent sulfur coal with wet scrubbers and 0.3 percent coal without wet scrubbers could be built in 1500 MW units anywhere."

"Thus, the air quality increment plan does not appear to be overly restrictive, particularly considering that in most areas similar facilities could be sited 25-50 miles of one another."

c. Additional costs are imposed upon a new plant if in order to comply with the air quality increment it must (a) build a taller stack than usual; (b) apply stack gas scrubbing for SO_2 removal (low sulfur fuel burning power plants only); (c) increase transportation and land costs where associated industrial activities must be separated geographically or it must move further from the market; or; (d) scale down its plant. Incremental costs imposed by the air quality increment appear to be relatively small, with the exception of power plants forced to add a scrubber while burning fuel which meets NSPS or power plants limited substantially in size.

- The cost of a stack approximately quadruples as its height doubles. A recent EPA study shows that for a large power plant the cost of a 400 foot stack (concrete 40 foot diameter) is about $1.25 MM while an 800 foot stack costs $5 MM--thus an incremental cost of almost $4 MM.

- The cost of adding a stack gas scrubber for SO_2 control to a low sulfur coal burning power plant is about $50 MM. For plants which could meet NSPS without such a scrubber, this would be an incremental cost of meeting the nondegradation increment.

• A power plant using coal from an open mine might also have to locate 10-20 miles from the mine to avoid violating the TSP increment. No estimate has yet been developed for the additional transportation cost.

• An alternative to building a stack twice as high would be building a plant only 30 percent as large. For example, the construction cost of a 300 MW power plant would be approximately 30 percent more per unit of capacity than for a 1000 MW plant. The investment cost for a 1000 MW power plant is about $410/kw. The cost of a 300 MW plant would then be $533/kw or an incremental cost of $123/kw. Thus the cost penalty is $123 million for building 1000 MW of total capacity in units of 300 MW rather than one 1000 MW plant. In view of the potential magnitude of such additional cost it is unlikely that a plant would scale down as long as it has the viable option of building a taller stack.

• A further cost of disaggregating a single large power plant into two smaller facilities is the additional land required for power transmission rights-of-way and other facilities that would have to be duplicated. It is estimated that 15 percent additional land would be required as a result of a second site. A single 3000 MW coal fired power plant requires 12,000 acreas. Thus an additional 1800 acres would be required.

B. Alternative II: Emissions Increment Plan

1. Regional Growth Impacts

a. The impact on regional growth varies widely with the size of the averaging area and the existing emission baseline. Regional inequities arise with averaging areas significantly smaller or larger than the proposed 10,000 square miles.

• Projected economic growth in the Greater Boston Metropolitan Area falls within a Priority I area and would not be subject to this regulation. However, projected emission density growth for both SO_2 and particulates exceeds the

allowable increments by a factor of five. The entire State of Massachusetts could not support new power plant growth projected for the Boston area alone.

- No growth restrictions are found for the Four Corners area even if the large AQCR is disaggregated into 10,000 square mile averaging areas. Large sources are dispersed evenly throughout the entire region.

- Dallas/Fort Worth violates the TSP emission limitation in six years under the 120 percent rule. Extensive controls applied to area sources as well as complete retrofit of all industries with BACT would allow projected growth to be accomodated for up to eleven or twelve years.

b. Power plants absorb a major portion of the allowable increments in growth areas, however the restriction of accessible electric power in turn restricts industrial and commercial development. Growth restrictions can be severe in such instances.

- The Plan would have critical consequences for development in New York State. The plan would restrict development after 1980 in much of the State (excluding AQCR's or counties with significant portions at or above Federal secondary standards with implementation plans in effect). The major impact would be a severe restriction in additional fossil-fuel power plants which in turn could curtail growth in industrial and commercial activity.

- Planned mine mouth power plant development in the Northern Great Plains coal formation could not be accommodated unless the averaging area were expanded to encompass six adjacent states.

c. There are no identifiable impacts on patterns of development within a region, as siting is not a consideration under this plan.

2. Industrial Growth and Energy-Related Sources

a. An emission limitation plan impacts most heavily upon power plants and related fuel development.

- Power plants account for 84 percent of TSP emissions and 98 percent of SO_2 emissions from all new industrial sources.

- Coal fired power plants in current clean air areas could be restricted in size to as little as 300 MW or as much as 1900 MW for every 10,000 square mile area depending upon the baseline.

b. In the absence of baseline aberrations, industrial growth projected to 1980 would not be affected by the increments, with the exception of any indirect impacts due to restrictions in power plant development.

- New industrial development to 1980, in its projected locations, will require only a fraction of the allowable increment.

- Most new industrial sources are projected for location in the rural and semi-rural areas of Priority I and II AQCR's and would therefore not be subject to Alternative II as proposed.

C. Alternative IV: Area Classification Plan

1. Regional Growth Impacts

a. Maintaining some areas of Zone 1 levels while allowing reasonable and planned growth in adjacent areas appears to be feasible.

- The State of New York has indicated that in 29 areas of study they were able to devise a crude area classification scheme which would maximize allowable growth to 1980 in the state. This plan gave 25 areas Zone 1 status for TSP, 13 areas Zone 1 status for SO_2 and exemption status to only two areas. Exemption status would be required for many more areas (nine) by 1990. This zoning is somewhat misleading in that all areas which currently exceed secondary standards were classified as Zone 1.

- The Grand Canyon could be designated Zone 1 without restricting resource development in the Four Corners Region.

b. A significant number of exceptions would be required by 1990 in high growth areas. (See Alternative I discussion.)

2. Industrial and Energy-Related Sources

Zone 1 restricts most industrial activities in the area with the exception of large (100,000 ton per year) Kraft Pulp and Paper Mills and small, well controlled power plants (150 MW meeting NSPS).

EXHIBIT I

AAQ INCREMENTS FOR ECONOMICALLY-SCARED PLANTS

(IN MICORGRAMS/M3)

	NSPS			NSPS & TALL STACK[1]		
	TSP Annual	SO_x Annual	SO_x 3-Hr.	TSP Annual	SO_x Annual	SO_x 3-Hr.
Required for:						
1000 MW Power Plant	2	6	520	1	2	158
170,000 TPY Copper Smelter	6[2]	4.5	330	2[2]	1.4	100
Copper Mine	30 } 36			30 } 32		
250,000 TPY Cement Plant	2[2]	-	-	0.5[2]	-	-
Quarry	13 } 15			13 } 13.5		
100,000 TPY Kraft Pulp Plant	2.8	1	-	0.8	0.3	-
120,000 TPY Aluminum Plant	1.5	2	180	0.5	0.6	55
180,000 TPY Zinc Smelter	12	6	290	4	2	88
4,380,000 TPY Steel Plant	20	0.5	-	6	0.2	-
Quarry	20 } 40			20 } 26		
Previously Proposed:						
Zone I	5	2	25	5	2	25
Zone II	10	15	300	10	15	300

1/ 400 feet versus 200 feet for power plant
600 feet versus 300 feet for copper smelter
200 feet versus 100 feet for cement plant
500 feet versus 250 feet for kraft pulp plant
400 feet versus 200 feet for aluminum plant
400 feet versus 200 feet for zinc plant
400 feet versus 200 feet for steel plant (tallest stack of several at plant)

2/ Assumes that the proportion of emissions from plant and quarry is equal to the proportional contribution of each source to ground concentration. This is at best a crude approximation. A diffusion model analysis must be performed.

SCIENTIFIC FACTORS BEARING ON REGULATORY POLICIES TO ASSURE NON-DEGRADATION OF AIR QUALITY

I. Overview

Most scenarios under which regulatory policies to assure non-degradation are conceived imply the existence of information and/or techniques which do not always exist. Specifically, assumptions are made as to abilities to measure, within limits of accuracy and precision which would be the result of the regulatory policy, the concentrations of the pollutants under consideration. In addition, it is implied usually that, once measured, these concentrations can be compared with "baseline" concentrations which are assumed to be known. Finally, it is often assumed that mathematical simulation techniques can be used to predict the air quality impact of land use policies sufficiently well to help define regulatory policy. It should be obvious that the knowledge and techniques mentioned above cannot be perfect and thus that the limits which exist on our ability to measure, model the transport, and determine "baseline" levels of the criteria air pollutants must, in turn, constrain regulatory policy options to some extent. It is the purpose of this paper to set forth the limitations which exist on our abilities in these areas so as to document the necessity for discarding many regulatory options which might otherwise seem obvious.

II. Measurement Capabilities

Total Suspended Particulate (TSP): The federal reference method for this pollutant is both sensitive (to 1 $\mu g/m^3$) and has reasonably low relative variation */ as shown:

Ambient Level Measured ($\mu g/m^3$)	Relative Variation ($\mu g/m^3$)
1	2
150	4.5
260	7.8

The technique appears adequate for most regulatory options related to non-degradation.

Sulfur Dioxide (SO_2): The federal reference method (prosaniline) for this pollutant is of limited sensitivity and rather poor relative variation. The lower limit of sensitivity of the method is on the close order of 30 $\mu g/m^3$ but has not been rigorously defined. The relative variations tabulated below are quite adequate for many regulatory purposes, but appear deficient for application to non-degradation of areas relatively low (below secondary standard) in SO_2.

Ambient Level Measured ($\mu g/m^3$)	Relative Variation ($\mu g/m^3$)
45	40
350	65
1300	120

Carbon Monoxide(CO): The federal reference method (non-dispersive IR) for this pollutant is of fair sensitivity (300 $\mu g/m^3$) but rather poor relative variation as shown:

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*/ Two measurements differing by an amount less than the relative variation cannot be interpreted as being significantly different to a 95% level of confidence.

Ambient Level Measured ($\mu g/m^3$)	Relative Variation ($\mu g/m^3$)
300	300
10,000	2500
40,000	2500

Since ambient concentration in clean environments may range as low as 150 $\mu g/m^3$, it seems clear that the technique would not be applicable to many non-degradation situations.

Photochemical Oxidants as Ozone: The federal reference method for this pollutant has sensitivity to approximately 50 $\mu g/m^3$. The relative variation of the method is reasonably good, as tabulated:

Ambient Level Measured ($\mu g/m^3$)	Relative Variation ($\mu g/m^3$)
50	10
160	12

At the present time, not enough is known about prevailing ambient levels to determine whether these performance characteristics are adequate, but there is some indication that levels below the sensitivity of the method are not uncommon.

Hydrocarbons: Due to the fact that the present federal reference method for total hydrocarbons does not distinguish between hydrocarbons from natural sources (trees, etc.), the levels of which may range widely, and man-generated hydrocarbons, it would be impossible to substantiate environmental degradation in the sense of this pollutant using the federal reference method.

Nitrogen Dioxide (NO_2): A federal reference method for this pollutant has not been promulgated at this time. Although there should be at least one adequate method among the existing interim methods, it

seems essential to first promulgate a federal reference method for use in this area before attempting to develop regulations.

Addendum: While the above performance discussions do define constraints placed on regulatory policy decisions by the capacity of the analytic methods, there is a further overlay of parameters which impact on the performance of field samplers using these methods. In order to analyse air quality it is necessary to pass a known amount of ambient air through the measurement device in a known period of time. Ideally, the air drawn through the device is all of consistant quality and is also representative of the area under consideration. This latter factor may, however, be a function of terrain, climatic conditions and proximity to sources of interference and thus all of these will bear on the number of measurements required to determine air quality to a desired degree of confidence. This additional influence on performance further mitigates against the use of air quality measurements in any active regulatory role vis-a-vis non-degradation.

III. Baseline Air Quality Information

TSP: The available data base on non-urban TSP levels is more extensive than that for any of the other criteria pollutants. Measurements have been taken over the period 1964-1972 at some forty non-urban National Air Sampling Network (NASN) stations.

The overall average TSP concentrations at all NASN non-urban stations for the period 1964-1972 was 35 $\mu g/m^3$ but the individual 9 year station averages ranged from 10 $\mu g/m^3$ (Yellowstone, Wyoming) to 68$\mu g/m^3$

(Cape Hatteras, N.C.). Individual yearly averages, of course, show even more variation and ranged from a low of 8 $\mu g/m^3$ (Yellowstone, 1967 and 1968) to a high of 110 $\mu g/m^3$ (Cape Hatteras, 1972.) Individual 24-hour values show a very wide variation with a low of $1\mu g/m^3$ in a number of stations to a high of $312\mu g/m^3$ (White Pine County, Nevada, 1965).

It is obvious from this information that there is extreme variation in TSP concentration between individual station annual averages and between the lowest and highest individual 24-hour value. Therefore, any decisions with respect to significant deterioration of air quality using these data must be made with full cognizance of the variability discussed above. Further, there is no significant difference between TSP data collected at non-urban NASN sites in 1972 and data compiled from either 1969-1972 or from 1964-1972; hence, 1972 data would be as good as starting point as any other single year from which to determine significant deterioration provided it is desirous to establish a single nationally applied baseline year. However, a nationally applied single-year baseline does not appear to be feasible because of the considerable year to year variability in data obtained from specific non-urban sites. Data from several years at a given sight are evidently necessary to establish a baseline level with any degree of confidence.

$\underline{SO_2}$: Although attempts to measure SO_2 at twenty-eight non-urban stations have been conducted over the past six years, the results of this effort force the conclusion that it will be essentiall, mpossible to establish any sort of baseline, nationally or area-wide, using the standard reference method. This is largely due to the insensitivity of the technique.

Other Criteria Pollutants: Although scattered data exist on concentrations of the other criteria pollutants in rural and wilderness areas, these data are in no way sufficient, either geographically or in terms of span of time covered, to suggest baseline concentrations for use in non-degradation enforcement activities.

Assessment: Extensive experience with measurement of suspended particulates (TSP) shows the danger of attempting to arrive at a determination of baseline levels from insufficient information. Further, the wide variability over time of concentrations measured at any point make it clear that extensive evidence would be required to document degradation of air quality from any established baseline. Although the standard reference method for TSP appears adequate to such a task, should it be determined necessary, this is not the case with most other criteria pollutants. In order to develop (as necessary), collaboratively test, and then promulgate appropriate analytic methods; and then apply them to determination of baseline air quality, nationally, would require the expenditure of resources on the order of hundreds of millions of dollars over a period of five to ten years. Finally, the use of this information for comparative purposes to show the degradation of air quality at a given site or set of sites would require extensive further measurement over periods of at least a year and perhaps more.

IV. Modelling Capabilities

In discussing this subject it is first essential to point out the necessity for excluding all of the photochemical pollutants (hydrocarbons, nitrogen oxides and oxidants) from any but very theoretical consideration.

At this time meteorological dispersion/simulation modelling of these pollutants is in the research stage only and validated models are not available. Previously proposed State Implementation Plans were based on an empirical relationship between hydrocarbons and ozone. Further research and development in the area of simulation of these pollutants is confined to atttempts to treat such heavily polluted areas as the Los Angeles Basin and would need to be drastically redirected to address relatively clean air regions (to account for hydrocarbons from vegetation, for example). In terms of the conservative pollutants (sulfur dioxide, carbon monoxide, and particulates) the use of mathematical modelling is often considered in two contexts: (1) use to calculate actual concentrations of pollutants under a given set of circumstances and (2) use to calculate the changes in concentrations of pollutants implied by changed circumstances (such as additional sources). The former use is the less developed of the two. For example, there is virtually no information or applicable past experience from which one could develop models to predict baseline air quality. However, the use of semi-empirical "Gaussian plume" models to relate pollutant concentration increases to additional sources of emission is reasonably well developed. These models have been assembled and validated for point, multiple point, and certain types of area sources. It should be pointed out, however, that the accuracy which can be expected of the models decreases as distance from the source increases and that many non-degradation applications require extending the application of the models beyond distance limits (perhaps ten miles) for which they have previously been validated. Further, the uniformity of meteorology and accuracy with which meteorological parameters are known over the region being simulated affects

the accuracy which can be expected. In general, we would expect to be able to predict the hourly average air quality increment due to additional point sources to within a factor of two (i.e., a predicted increment of 10$\mu g/m^3$, would have a "range of truth" of from 5 to 20$\mu g/m^3$) at least half the time. Predicted annual average increments will range within a factor of 1.5 of the observed average increment at least half the time. Thus even in the best case the possible errors in the modelling process due to for example, uncertainties in meteorological parameters may overwhelm the air quality increment under consideration.

Mathematical simulation does, however, provide a consistant, reproducible way to estimate "hypothetical" air quality increments for conservative pollutants. The development of enforcement scenarios utilizing mathematical models and controlling against such hypothetical (but uniformly reproducible) air quality increments, appear to have some merit.

V. Conclusions

Measurement: Although the federal reference method for suspended particulate is evidently adequate, the federal reference methods for other criteria pollutants at low (clean environment) concentrations suffer varying degrees of inadequacy. Extensive modification of existing methods or the development of new methods would be required in order to develop a capacity for determining significant deterioration using a "ground truth" approach.

Extant Air Quality Data: Only data on suspended particulate concentrations are extensive enough to be meaningful. The major conclusion which can be drawn is that vast numbers of measurements are

required to first determine a baseline level and then further extensive measurements are needed to establish degradation from that level.

Modelling/Simulation: The use of simulation techniques to predict concentrations of the non-conservative pollutants (oxidants, hydrocarbons, and nitrogen oxides) is scientifically indefensible at the present time. Simulation techniques may have some utility in non-degradation enforcement in that they allow the establishment of a logically consistant enforcement posture predicated on limiting the incremental increase in "hypothetical" concentrations of conservative pollutants.

Reference 13

AVAILABILITY OF AIR QUALITY DATA IN AREAS
GENERALLY BELOW THE NAAQS

In order to estimate the number of monitoring stations which are located in areas which are generally below the NAAQS, the 1973 Monitoring and Air Quality Trends Report (EPA -450/1-74-007) was examined to determine the number of urban versus rural sites. Although it is probably improper to assume that urban areas are above standards while all rural areas are below standards, the following table does illustrate how little monitoring is being done in the rural, generally clean, areas.

Pollutant	Total number of sites	Number of sites reporting at least one valid quarter of data	Number of valid rural sites
TSP	3591	3390	136
SO_2	2132	1615	55
CO	289	213	0
Oxidant(O_3)	252	188	0
NO_x	---	588	40

Reference 14

TECHNICAL DATA IN SUPPORT
OF
SIGNIFICANT DETERIORATION ISSUE

ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Research Triangle Park, N.C. 27711

TECHNICAL SUPPORTING DATA TO ACCOMPANY PROPOSED RULE MAKING ON PREVENTION OF SIGNIFICANT AIR QUALITY DETERIORATION FEDERAL REGISTER DATED JULY 16, 1973 VOLUME 38, NO. 135, PART IV, PAGE 18985

All data presented herein are estimated, based upon typical conditions. Many of the specific values represent averages from which the range of values exceeds several orders of magnitude. Although the data are adequate as a guide for impact assessments of alternative plans, they are not intended for use in assessing the impact on individual sources, facilities, or AQCRs.

TABLE 1. SOURCE CATEGORIES

All of the options set forth in the proposed rule making for preventing significant air quality deterioration require review of certain types of stationary sources. Table 1 identifies the sixteen sources subject to review along with the related information on annual construction estimates and source size statistics. This list represents the Administrator's best judgment as to which sources individually have the potential for causing "significant deterioration." The sixteen source categories account for approximately 30 percent of the particulate matter and 75 percent of the sulfur dioxide emitted into the atmosphere each year nationwide, and account for essentially all of these pollutants emitted in clean areas.

TABLE 2. COMPUTATION OF EMISSIONS FROM SELECTED CATEGORIES

Table 2 shows emissions estimates for the sixteen source categories identified in Table 1. Estimates assume the application of "best available control technology" and are for an average size facility.

TABLE 3. CALCULATED MAXIMUM POLLUTANT CONCENTRATIONS FOR SELECTED POWER PLANTS USING OBSERVED STABILITY WIND ROSES - GOOD DISPERSION AND TERRAIN ASSUMED

Table 3 shows the calculated total suspended particulate (TSP) and sulfur dioxide (SO_2) concentrations associated with fourteen different power plants. The list represents a variety of coal burning power plants with different capacities, volumes, stack gas temperatures and stack heights.

TABLE 4. CALCULATED IMPACT OF SELECTED POWER PLANTS ON SHORT-TERM AIR QUALITY

This table shows the estimated maximum short-term pollutant concentrations in the vicinity of five large power plants with various stack configurations. The modified values represent those concentrations corrected to reflect application of best available control technology.

TABLE 5. CALCULATED IMPACT OF SELECTED AREA SOURCES ON SHORT-TERM AIR QUALITY

Emissions of SO_2 and TSP from three area sources plus the predicted impact of these sources on air quality are listed in Table 5. All sources are assumed to burn .3% sulfur oil.

TABLE 6. CALCULATED POLLUTANT CONCENTRATIONS RESULTING FROM POINT SOURCES IN HYPOTHETICAL AQCRs

Table 6 illustrates the impact of five point sources on air quality in hypothetical AQCRs. Resulting concentrations assume application of "best available control technology" and are given for both open and valley terrain.

TABLE 7. CURRENT AMBIENT AIR QUALITY STANDARDS

Table 7 identifies current primary and secondary ambient air quality standards for TSP and SO_2.

TABLE 8. ESTIMATED COSTS OF EMISSION CONTROLS FOR SELECTED SOURCE CATEGORIES

Table 8 provides an estimate of control costs for selected source categories. Cost figures assume application of best available control technology.

FIGURE 1. DISTRIBUTION OF PRIORITY III AQCRs BY CAPACITY TO SUPPORT INCREASES IN TOTAL SO_2 EMISSIONS

Figure 1 is a cumulative distribution of AQCRs based on their capacity to support additional SO_2 emissions. The distribution assumes a maximum allowable increase in emissions of 20% over those levels that existed in a sample baseline year. Interpretation of the figure is best illustrated through an example: approximately 40 percent of all Priority III AQCRs cannot support a total increase in SO_2 emissions of 30,000 tons per year. Alternatively, 60 percent of the Priority III AQCRs can support a single source, or combination of sources, resulting in 30,000 tons of annual SO_2 emissions.

FIGURE 2. DISTRIBUTION OF PRIORITY III AQCRs BY CAPACITY TO SUPPORT INCREASES IN TSP EMISSIONS.

This is a distribution similar to Figure 1 but based on TSP emissions. For example, approximately 83 percent of all Priority III AQCRs cannot support a total annual TSP emission increase of 40,000 tons. Figure 2 also assumes a 20 percent allowable increase in TSP emissions over the baseline values.

NOTE: Unless specified otherwise, data for power plants are based on the alternate definition of best available control technology.

TABLE 1

SOURCE CATEGORIES REVIEWED

SOURCE CATEGORY	EXPECTED NO. PER YEAR	AFFECTED SIZE	SIZE DISTRIBUTION AVG.	RANGE
Fossil Fuel Fired Steam Electric Power Plants	40	100 MW	600 MW	50-1200 MW
Coal Cleaning Plants	9	ALL	465 TPH	100-1000 TPH
Kraft Pulp Mills (Recovery Furnaces)	15	ALL	800 TPD	500-1500 TPD
Portland Cement Plants	6	ALL	100 TPH	75-300 TPH
Primary Zinc Smelters	2	ALL	280 TPD (Metal)	200-900 TPD
Iron and Steel Mill Metallurgical Furnaces	8 Elec Arc 6 BOF	ALL	200 T/heat	100-325 T/heat
Primary Aluminum Ore Reduction	1	ALL	480 TPD	95-740 TPD
Primary Copper Smelters	2	ALL	260 TPD (Metal)	125-1000 TPD
Municipal Incinerators	25	250 TPD	300 TPD	50-1000 TPD
Sulfuric Acid Plants	2	ALL	750 TPD	500-1500 TPD
Petroleum Refineries (Cat. Crackers)	3	ALL	10×10^4 bbl/day	$40\text{-}200 \times 10^3$ bbl/day
Lime Plants	7	ALL	450 TPD	240-600 TPD
Phosphate Rock Processing Plants (Process Unit)	4	ALL	1200 TPD	550-1650 TPD
By Product Coke Oven Batteries	3.5	ALL	180 TPH	70-360 TPH
Sulfur Recovery Plants	8	ALL	140 TPD	27-270 TPD
Carbon Black Plants	1.4	ALL	120 TPD	109-270 TPD

TABLE 2

COMPUTATION OF EMISSIONS FROM SELECTED SOURCE CATEGORIES

PLANT TYPE	AVG SIZE	EMISSION* FACTOR TSP	EMISSION* FACTOR SO_2	OPERATING TIME (HRS)	ANNUAL EMISSION** TSP (T/YR)	ANNUAL EMISSION** SO_2 (T/YR)
Fossil Fuel Fired Steam Electric Power Plants	600 MW (6000×10^6 BTU/HR)	0.1 lbs/10^6 BTU	1.2 lbs/10^6 BTU	8760	2600	30,000
Coal Cleaning Plants	465 T/HR	0.13 lbs/T	--	5600	175	--
Kraft Pulp Mills (Recovery Furnaces)	33 T/HR	1.55 lbs/T	--	8400	200	--
Portland Cement Plants	100 T/HR	0.[illegible] lbs/T	--	8760	125	--
Primary Zinc Smelters	560 T/Day	1.0 lbs/T	31.7 lbs/T	8760	100	3,000
Iron and Steel Mill Metallurgical Furnaces***	100 T/HR	0.31 lbs/T	--	8760	125	--
Primary Aluminum Ore Reduction	480 T/Day	6.5 lbs/T	--	8760	550	--
Primary Copper Smelters	1040 T/Day (Conc. Ore)	0.68 lbs/T	20.2 lbs/T	8760	150	4,000
Municipal Incinerators	300 T/Day	1.65 lbs/T	--	7500	75	--
Sulfuric Acid Plants	750 T/Day	--	4 lbs/T	8400	--	500
Petroleum Refineries (Cat. Crackers)	100,000 Bbl/Day	26 lbs/hr	325 T/hr	8760	450	3,000

TABLE 2 (CONTINUED)

PLANT TYPE	AVG. SIZE	EMISSION* FACTOR TSP	EMISSION* FACTOR SO_2	OPERATING TIME (HRS)	ANNUAL EMISSION** TSP (T/YR)	ANNUAL EMISSION** SO_2 (T/YR)
Lime Plants	450 T/Day	1.5 lbs/T				
Phosphate Rock Processing Plants	1200 T/Day	0.67 lbs/T	--	8760	150	--
By Product Coke Oven Batteries	200 lbs/HR	0.052 lbs/T	0.16 lbs/T	8760	50	150
Sulfur Recovery Plants	140 T/Day		2 lbs/T	8400	--	50
Carbon Black Plants	120 T/Day	2 lbs/T	--	8760	50	--

*Level of estimated best available control technology.

**These are approximate values and do not reflect a strict mathematical relationship with other data in this table.

***These data represent an average between electric arc and basic oxygen furnaces.

TABLE 3

CALCULATED MAXIMUM POLLUTANT CONCENTRATIONS FOR SELECTED POWER PLANTS*
USING OBSERVED STABILITY WIND ROSES - GOOD DISPERSION AND TERRAIN ASSUMED

Plant Number	Capacity (MW)	Volume (M^3/Sec)	Stack Gas Temp.(°F)	Stack Height (M)	24-Hr. SO_2 ($\mu g/m^3$)	3-Hr. SO_2 ($\mu g/m^3$)	24-Hr. TSP ($\mu g/m^3$)
1	444	177	430	94	52.8	160.08	7.5
2	414	182	410	76	52	227.36	7.8
3	53	25	500	31	24.4	75.4	10.2
4	75	60	430	60	9.5	52.78	2.4
5	908	130	400	91	106.4	513.3	13.7
6	133	88	440	44	54.3	309.72	5.6
7	221	100	436	92	18.5	88.16	3.5
8	450	456	415	168	21	48.72	1.9
9	531	1218	361	152	36.1	72.0	
10	100	51	405	69	17.3	71.0	5.1
11	396	210	460	76	29.3	175.16	4.9
12	308	70	450	65	57	356.7	8.1
13	59	200	450	83	9.5	55.1	0.59
14	1304	440	422	208	56	137	1.2

*Existing coal burning plants assumed to meet NSPS by burning 0.7%S coal.

TABLE 4

CALCULATED IMPACT OF SELECTED POWER PLANTS ON SHORT-TERM AIR QUALITY

SOURCE DESCRIPTION	FUEL PRESENT	FUEL ASSUMED	MEASURED 1-HR. SO_2	MODIFIED* 3-HR. SO_2	DISTANCE TO MAX. CONCENTRATION (KM)
1000 MW Plant Flat Terrain 2-450 Ft. Stacks	1.5%S Coal	0.7%S Coal	1048 $\mu g/m^3$	273 $\mu g/m^3$	5-6
1500 MW Plant Flat Terrain 10-250 Ft. Stacks	3%S Coal	0.7%S Coal	2358 $\mu g/m^3$	319 $\mu g/m^3$	4
120 MW Plant 2-265 Ft. Stacks	1.3%S Coal	0.7%S Coal	733 $\mu g/m^3$	275 $\mu g/m^3$	3
455 MW Plant Rolling Terrain 3-400 Ft. Stacks	2.2%S Coal	0.7%S Coal	825 $\mu g/m^3$	150.8 $\mu g/m^3$	3
1700 MW Plant Flat Terrain 2-600 Ft. Stack 1-800 Ft. Stack	3.8%S Coal	0.7%S Coal	2600 $\mu g/m^3$	304 $\mu g/m^3$	18

*Modified impact based on measured data X $1-\left(\frac{\%S\ Coal - .7}{\%S\ Coal}\right)$ to adjust emissions to reflect NSPS.

TABLE 5

CALCULATED IMPACT OF SELECTED AREA SOURCES ON SHORT-TERM AIR QUALITY

SOURCE DESCRIPTION	FUEL	EMISSION (TONS/YR.) SO_2	EMISSION (TONS/YR.) TSP	3-HR SO_2 ($\mu g/m^3$)	1-HR. TSP ($\mu g/m^3$)
Polo Grounds - NYC 1,614 Units Area = 0.9 Sq. Km.	0.3%S Residual Oil	26	14.1	21.5	18
Parkchester Manor - NYC 12,271 Units Area = 0.8 Sq. Km	0.3%S Residual Oil	151	73	35.4	30
Co-op City - NYC 15,375 Units Area = 1.1 Sq. Km	0.3%S Residual Oil	376	184	70.18	59

TABLE 6

CALCULATED POLLUTANT CONCENTRATIONS RESULTING FROM RURAL POINT SOURCES IN HYPOTHETICAL AQCRs*

	OPEN TERRAIN				VALLEY TERRAIN			
	SO_2 ($\mu g/m^3$)		TSP ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		TSP ($\mu g/m^3$)	
Source Type	24-Hr.	Annual	24-Hr.	Annual	24-Hr.	Annual	24-Hr.	Annual
Bi-Product Coke Oven	1.6	0.3	0.7	0.6	2.4	0.3	2.1	0.6
Cement Plant	-	-	5.0	0.7	-	-	0.5	0.1
Petroleum Refinery	110	23	8	-	122	26	10	-
Power Plant (700 MW)	75**	10	36	-	345**	13	40	-
Municipal Incinerator	-	-	20	-	-	-	20	-

*AQCRs and plants taken from National Emission Standards Study (1970).

**High concentrations due to short stack (122M) and large size (700 MW).

The figures in this table represent those concentrations estimated to accompany the Best Available Control Technology.

TABLE 7

CURRENT AMBIENT AIR QUALITY STANDARDS

	TSP ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)
3-Hour	--	1300**
24-Hour	150**	365*
Annual	75*	80*

* Primary Standards

** Secondary Standards

TABLE 8

ESTIMATED COSTS* OF EMISSION CONTROLS
FOR SELECTED SOURCE CATEGORIES

SOURCE	COST $(000) CAPITAL	ANNUAL
Fossil Fuel Fired Steam Electric Power Plants **	25,000	7,150
Coal Cleaning Plants	304	137
Kraft Pulp Mills (Recovery Furnaces	1,467	450
Portland Cement Plants	1,030	355
Primary Zinc Smelters	14,502	3,990
Iron and Steel Mill Metallurgical Furnaces	7,400	2,751
Primary Aluminum Ore Reduction	10,000	1,600
Primary Copper Smelters	39,500	12,400
Municipal Incinerators	300	106
Sulfuric Acid Plants	551	310
Petroleum Refineries (Cat. Crackers)	700	150
Lime Plants	300	70.6
Phosphate Rock Processing Plants (Process Unit)	800	190
By Product Coke Oven Batteries	8,000	N/A ***
Sulfur Recovery Plants	800	224
Carbon Black Plants	270	56

*Cost estimates are for an average size facility as identified in Table 1 and assume application of best available control technology.

**Assumes the primary definition of BACT for plants requiring stack gas cleaning. Costs for the alternative definition of BACT would vary from 0 to this figure, depending primarily upon availability of low sulfur coal.

***Operating costs are not available for these systems.

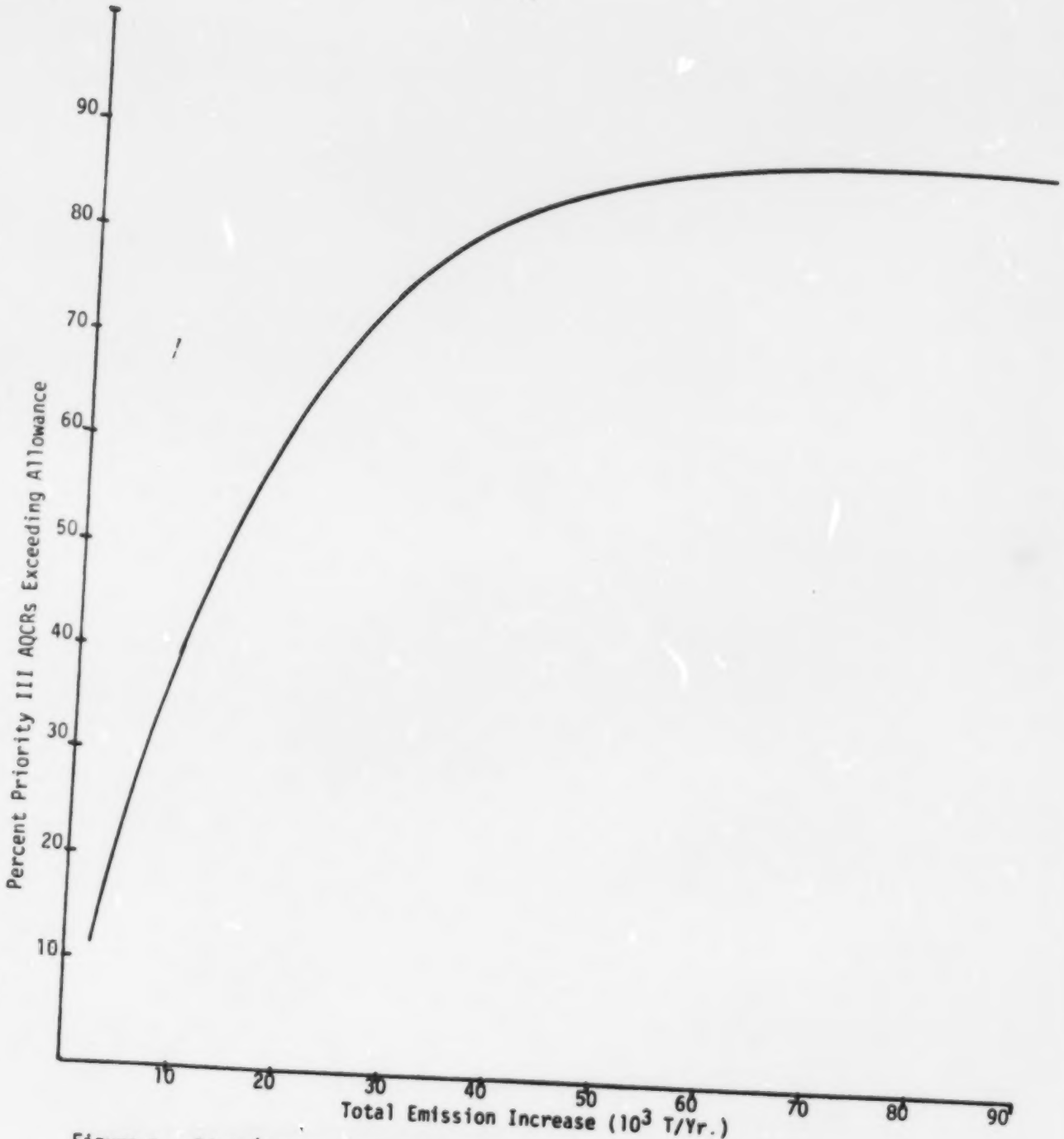

Figure 2. Distribution of Priority III AQCRs by capacity to support increases in total TSP emissions. (Allowance is 20% increase over 1970* emissions.)

* 1970 is a sample year and was selected because of data availability at the time this figure was prepared.

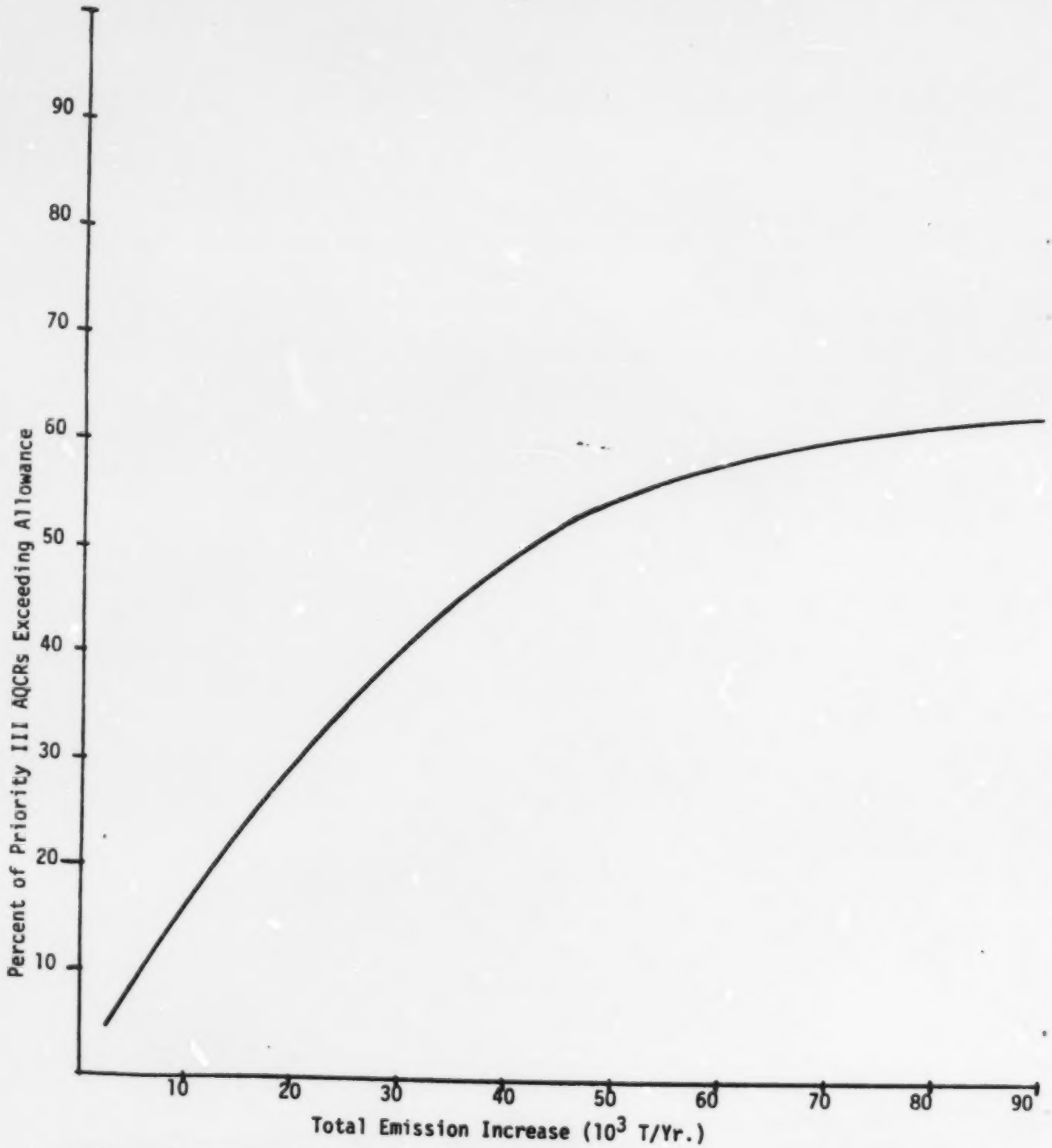

Figure 1. Distribution of Priority III AQCRs by capacity to support increases in SO_2 emissions. (Allowance is 20% increase over 1970* emissions.)

* 1970 is a sample year and was selected because of data availability at the time this figure was prepared.

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Reference 15

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards

SUBJECT: Non-degradation and Power Plant Size DATE: AUG 12 1974

FROM: Joseph A. Tikvart, Chief
Model Application Section, SRAB

TO: Richard G. Rhoads
Special Assistant, OAQPS

THRU: Herschel H. Slater, Chief
Source Receptor Analysis Branch, MDAD

At your request, I have reviewed the allowable concentration increases applicable to a Class II area designation for prevention of significant deterioration. The size (megawatts) power plant which conforms with specified concentration increments was examined. Similar studies by TRW for the Department of the Interior and by Harbridge House for EPA were also reviewed.

As a result of this study, I find it likely that an 800 MW power plant which meets new source performance standards will not exceed the allowable 24-hour concentration increment (100 $\mu g/m^3$). Generally, this same plant will not exceed a 3-hour concentration increment of 600 $\mu g/m^3$. (A stack height of about 400 feet has been assumed.) Also, in most cases a 1,000 MW plant will not exceed the 24-hour increment. However, for a plant of this size, an allowable 3-hour increment of 750 $\mu g/m^3$ is more appropriate. The plant sizes discussed above will increase, if greater stack heights or reduced pollutant emissions are considered. It should be noted that a power plant in the size ranges discussed here may endanger a Zone I increment for a distance of 80 miles downwind under poor dispersion conditions.

As you are aware, the impact of individual power plants on air quality is highly variable. To determine impacts for specific power plants, a plant-by-plant analysis is required. The above plant size estimates are general "rules of thumb" only.

The basis for these findings is documented in the enclosure.

Enclosure

EPA Form 1320-6 (Rev. 6-72)

REVIEW OF NON-DEGRADATION LIMITATIONS ON POWER PLANT SIZE

TRW Study

The study by TRW attempts to relate an allowable power plant size which meets non-degradation requirements to various areas of the United States. It concludes that a power plant with a 400 foot high stack and emissions which meet new source performance standards (NSPS) should be less than 800 MW in size if located in the Southeastern United States. If located in other parts of the United States, a size less than 1500 MW is required.

Unfortunately, the report does not document the basis for relationships used between concentration averaging times or between regions. Nor is the basic dispersion model which was used identified adequately. Thus the conclusions of the study can be considered to be tenuous, at best.

Harbridge House Study

The study by Harbridge House considers the impact of power plants in three regions of the United States, e.g. Boston, Four Corners Area, and Iowa. The impact of individual power plants in Boston were not considered in this report. The power plants considered in the Four Corners Area and Iowa were assumed to meet NSPS and to have a stack height of 250 feet. From the concentration estimates for these power plants, it was concluded that a plant size in the range of 500 to 800 MW allows the acceptable 3-hour increment to be met. Concentration estimates for an averaging time of 24 hours were not made.

It should be noted that the model used in the Harbridge House Study is basically applicable to estimating long-term average pollutant concentrations. As such, the algorithm which determines the horizontal plume dispersion is 3-4 times greater than a similar algorithm used in estimating short-term (1 hour) concentrations. Data collected by TVA around the Paradise Steam Plant indicates that the ratio of 3-hour average concentrations to the 1-hour average was 0.8 as much as 20% of the time. The peak, median, and minimum ratios were 0.94, 0.66, and 0.44, respectively. Thus it can be concluded that the 3-hour average concentrations estimated by Harbridge House may be low by a factor of 2 to 4.

Source Receptor Analysis Branch (SRAB) Analysis

To obtain a crude estimate of the power plant size which will not exceed the allowable concentration increments for a Zone II area, SRAB employed the point source dispersion model described in "Requirements for Preparation, Adoption and Submittal of Implementation Plans--Appendix A" (FR 36 15494). This model of limited mixing is the critical plume dispersion model for sources with tall stacks. TVA has indicated that such a model may be applicable at distances of 5-10 kilometers downwind from the source. Meteorological conditions of a 500 meter mixing height and a wind speed of 5 m/s were assumed in the model. While these conditions severely limit dispersion, they are not uncommon in many parts of the United States. More severe conditions also occur in many areas. The concentration estimates from this model indicate that a power plant of

600-800 MW should not endanger the applicable increment for 24-hour averages; however, the size must be limited to 400-600 MW to meet the allowable 3-hour increment. So that a 600-800 MW plant could meet both the 3-hour and 24-hour increments, the allowable 3-hour increment would have to be increased to 400-450 $\mu g/m^3$.

A related question is concerned with the location of such a power plant near a Zone I boundary. Zone I allowable concentration increments are only 5-13% of Zone II allowable increments. By using the limited mixing model indicated above, it was determined that a plant which just meets the Zone II increment, may exceed the Zone I increment for a distance as great as 80 miles downwind. Thus it appears that such a power plant should not be located any closer than 80 miles from the nearest Zone I boundary.

To supplement the basis for assuming that a power plant larger than 600-800 MW could exceed both the 3-hour and 24-hour Zone II allowable increments, data from the EPA funded Walden Power Plant Study were employed. First, all power plants with actual stack heights in the range of 400 to 600 feet were selected. The reason for this selection is an arbitrary definition of good engineering practice (GEP) stack height. In its simplest form, in flat terrain a GEP stack is one which is 2-1/2 times the height of nearby structures. Since nearby structures routinely include a boiler house the stack should be 2-1/2 times this structure. From the data available it appears that typical boiler houses on new plants are about 150 feet high; this would require a GEP stack of

400 feet. Next, the relationship of stack height to surrounding terrain was examined. Only those 15 plants with stacks 300 feet or higher than surrounding terrain were analyzed further. These stacks were reviewed for their impact on 1-hour, 24-hour, and annual average concentrations with the assumption that they met NSPS. The impact with NSPS was then compared to the allowable Zone II concentration increment.

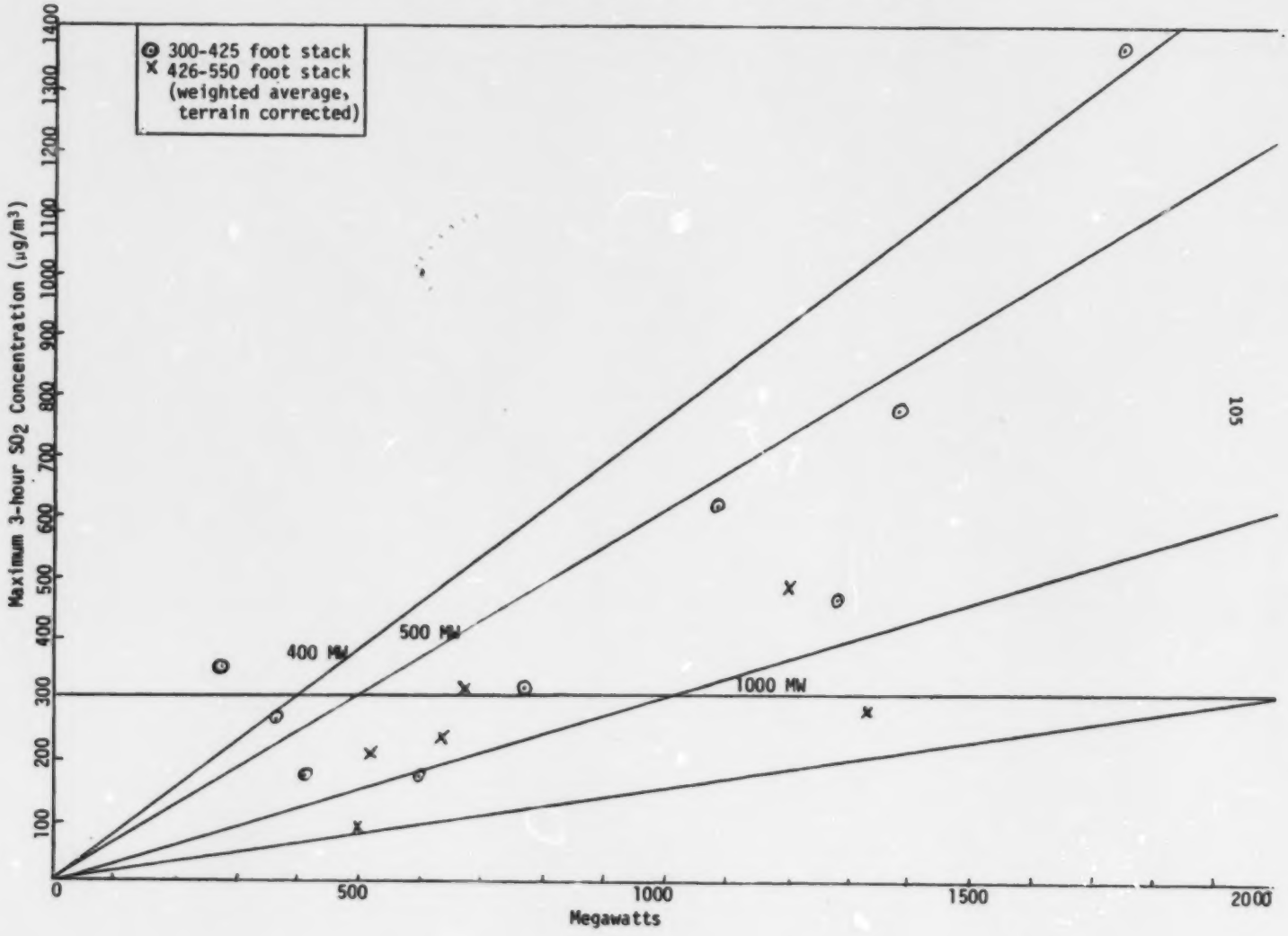
The attached figures indicate plant size (MW) versus maximum concentrations for 3-hours and for 24-hours for plants assumed to meet NSPS. Lines indicate the relationship between plant size and concentration that is necessary for 2000, 1000, and 800 MW plants to meet required increments. Plants above the line will exceed the allowable increment; plants below will be within allowable concentrations. For the 24-hour average concentrations it is quite apparent that if the plants investigated were 2000 MW in size, more than half would cause the 24-hour increment to be exceeded. A 1000 MW plant would allow most of the plants to meet the allowable increment, while a 500 MW plant would insure that all plants would meet the allowable increment. This is consistent with the earlier finding that a 600-800 MW plant is required to meet the allowable increment.

Estimates for 3-hour concentrations were not available for most of the plants considered, only 1-hour averages. For 3 plants on which data were available, the 3 hour/1 hour ratio varied from 0.44 to 0.69; this is within the range of observed ratios discussed above. Thus to be conservative, the 3-hour ratio of 0.8 also discussed above is employed here. The estimated maximum 1-hour concentrations were reduced by 20% to estimate

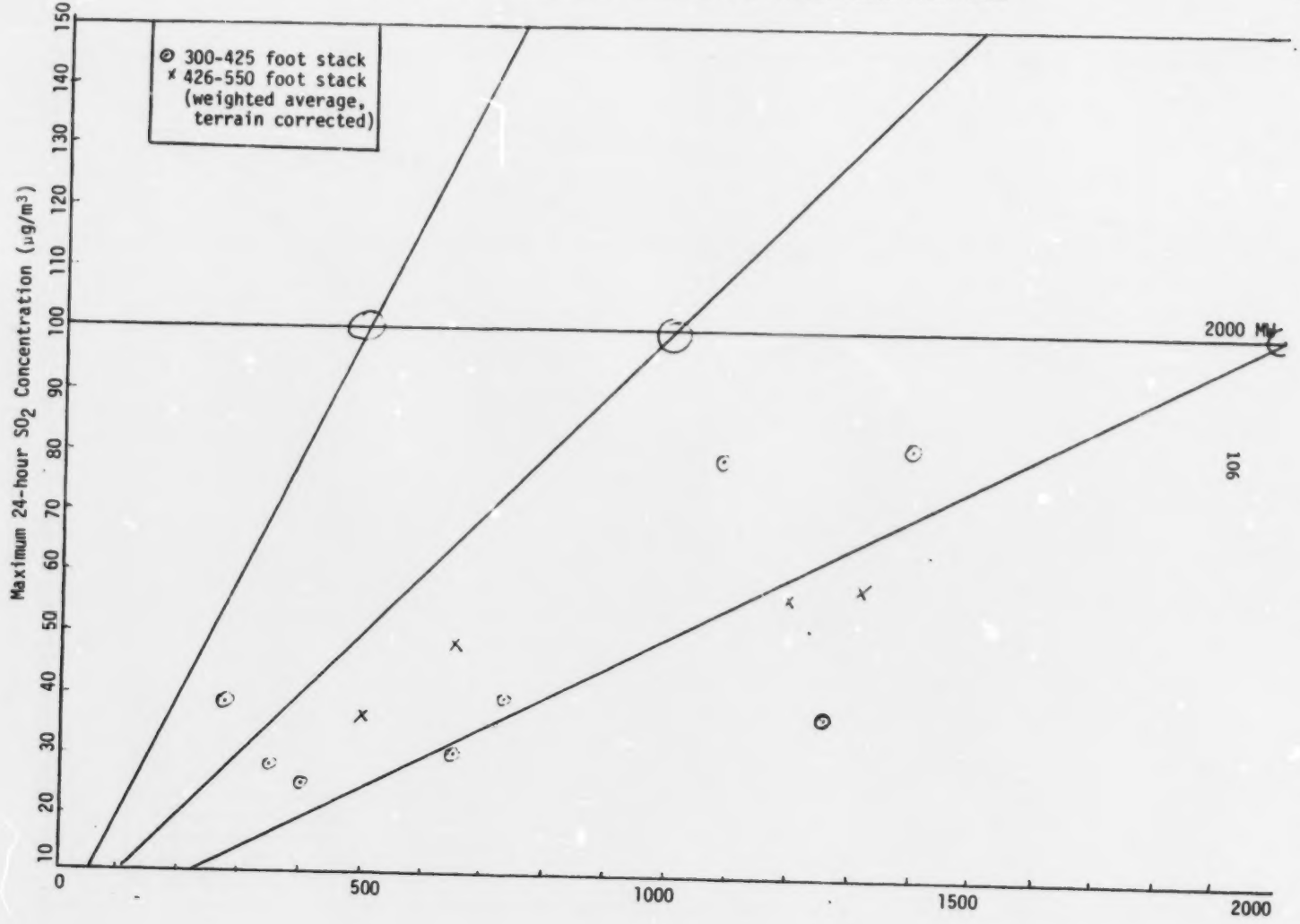
the 3-hour concentrations. This is done with the understanding that this ratio has wide variation.

For 3-hour average concentrations it is clear that any plant larger than 400 MW can cause the 3-hour increment to be endangered. Though there are plants that exceed the allowable increment, none of these plants have stacks greater than 400 feet. It appears that if the allowable 3-hour increment is doubled to 600 $\mu g/m^3$, most 800 MW plants should not exceed the standard. This estimate is somewhat greater than that obtained from the limited mixing model analysis.

Estimated Maximum 3-hour Concentration versus Power Plant Size



Estimated Maximum 24-hour Concentration versus Power Plant Size



Reference 16

Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

Significant Deterioration in Zone I Areas and the Relative Location of Power Plants — Oct. 15, 1974

Joseph A. Tikvart, Chief Signed
Model Application Section

The Files

The Zone I allowable 24 hour average concentration increments to prevent significant deterioration for SO_2 and particulate matter are 5 $\mu g/m^3$ and 10 $\mu g/m^3$, respectively. It is possible that a power plant located in a Zone II or Zone III area could meet the allowable increment for these latter areas but still exceed the allowable increment for adjacent Zone I area. This brief analysis considers the distance a plant must be located from a Zone I area to avoid exceeding the allowable concentration increments.

The concentration that a source causes at a given downwind distance depends on the pollutant emissions, physical plant characteristics and meteorological conditions. To simplify this analysis a few generalized assumptions are made. The source is assumed to be a 1000MW power plant which meets new source performance standards (NSPS); thus its SO_2 and particulate emissions are estimated to be approximately 1000 g/s and 100 g/s, respectively. The plant has a 400 foot high stack with a plume rise equal to the stack height, e.g., effective stack height is approximately 250 meters. It is further assumed that vertical mixing of the plume is limited to 500 meters and that the average wind speed is 5 m/s (18 kilometers per hour); slightly unstable (Pasquill Class "C") conditions occur within the mixing layer. These conditions may occur with a steady wind direction for periods up to 6 hours; however, the wind direction itself may persist for considerably longer periods.

Such meteorological conditions resulting in poor dispersion of the pollutant are not uncommon in many parts of the United States. Even in areas with generally good dispersion conditions, such adverse conditions may occur on a limited number of occasions.

With the above indicated plant and meteorological conditions, the maximum 24-hour SO_2 concentration caused by the plant would be approximately 100 $\mu g/m^3$ at a distance of 3 kilometers downwind from the plant. Thus the concentration just meets the Zone II allowable increment. The change in SO_2 concentration with distance downwind from the plant is shown in Figure 1. It can be seen that if no decay of SO_2 is assumed the concentration reaches a level of 5 $\mu g/m^3$ at a distance of 80-100 kilometers. If an SO_2 half-life of 12 or 4 hours is assumed, the level of 5 $\mu g/m^3$ is reached closer to the stack. It should be noted that beyond 80 kilometers the concentration decreases very slowly with increases in distance. Since Figure 1 has a scale of 0-100 for concentration, these

values can be used as a percentage. Therefore if a similar 2000MW plant in a Zone III area caused a maximum concentration of 200 $\mu g/m^3$, then a concentration of 5% of this value or 10 $\mu g/m^3$ would result at a distance of 80-100 kilometers, if there was no SO_2 decay. Due to the relative stringency of the Zone I 24-hour SO_2 increment, it is the most difficult to meet. In most cases, if the 24-hour increment is met, then the 3-hour and annual increments are also likely to be met.

A distance of 100 kilometers at a wind speed of 5 meters per second requires a travel time of nearly 6 hours. Thus, if the phenomena which causes the significant concentrations at 100 kilometers also lasts for 6 hours, a persistent wind for 12 hours is implicit in the analysis. Since there is little information on dispersion beyond 100 kilometers and any assumption of persistence for periods longer than 12 hours are extremely tenuous, Figure I is not extended beyond 100 kilometers. Such an extension should be attempted only for specific topographic and climatological conditions and only then with great care.

Figure II indicates 24-hour particulate concentrations caused by a 1000MW plant meeting NSPS. It can be seen that such a well controlled plant will meet the Zone I allowable concentration increment of 10 $\mu g/m^3$. Even if SO_2 with a half-life of 4 hours is converted entirely to ammonium sulfate and treated as particulate matter, a concentration of 10 $\mu g/m^3$ is reached within 10 kilometers downwind of the source. For larger sources a proportional increase in maximum concentration can be assumed, and the percent decrease with distance implied by Figure II used.

Thus, from the above analysis it can be concluded that it is reasonable to expect a 1000MW plant meeting NSPS to endanger the Zone I SO_2 increment to a distance of 50-60 miles downwind. For larger plants located for example in a Zone III area this increment will be endangered for greater distances downwind. A separate analysis for such situations on an individual basis appears desirable. The impact of such sources on the particulate increment does not appear to be a problem.

It should be noted that the above analysis is for a generalized source. Thus, conclusions drawn about downwind distances at which the plant has a significant effect can be considered "rules of thumb", at best. If any changes in the physical characteristics of the plant or the meteorological conditions are made, significantly different concentrations may be estimated at downwind distances. This is especially important since relatively small changes in concentration are critical in the consideration of air quality deterioration.

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Figure 1

SO_2 Concentration versus Distance

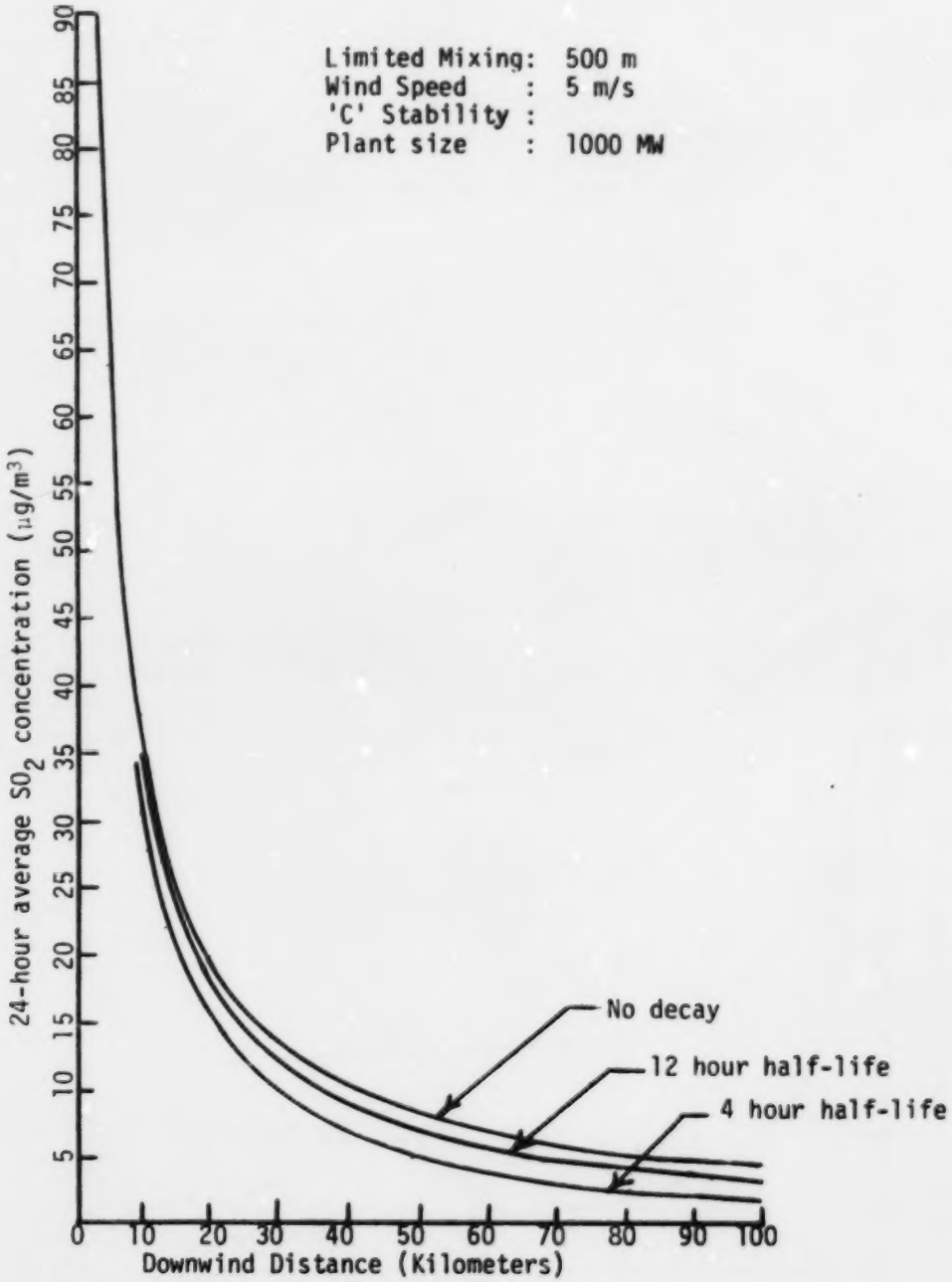
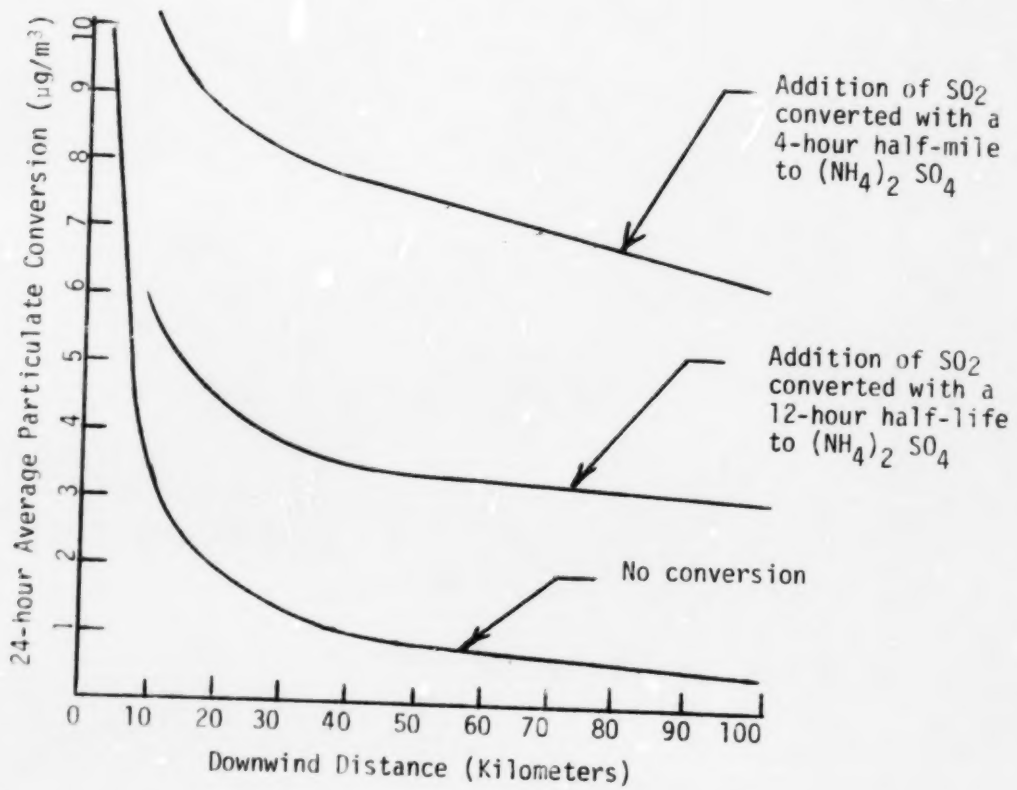

Limited Mixing: 500 m
Wind Speed : 5 m/s
'C' Stability :
Plant size : 1000 MW
24-hour average SO2 concentration (μg/m3)
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
0 10 20 30 40 50 60 70 80 90 100
Downwind Distance (Kilometers)
No decay
12 hour half-life
4 hour half-life

Figure 2

Particulate Concentration versus Distance

Limited Mixing: 500m
Wind speed : 5 m/s
"C" Stability :
Plant Size : 1000MW



Reference 17

DISCUSSION PAPER ON THE MAGNITUDE OF THE CLASS II INCREMENT IN THE SIGNIFICANT DETERIORATION REGULATIONS

THE ISSUE

The draft regulations incorporate the same general definition of the Class II increment as was incorporated in the proposal of July 16, 1973, and incorporate the same provision that this increment serve as the initial area classification nationwide. It has been suggested that the increment be doubled.

EXPLANATION

The primary reason for doubling the increment is to permit a larger growth potential - with primary concern for coal-fired power plants - during the interim period until States redesignate their territory. The provision for States to redesignate their territory according to local desires is not an issue. The provision for EPA to perform an initial designation as Class II is also not an issue. The issue is solely whether the Class II increment should remain as proposed, or whether it should be doubled.

DISCUSSION

Point 1. The Class II increment is adequate to permit normal, well-controlled, commercial and industrial construction in most areas of the country. The current increment was developed to permit the amount and type of polluting growth which is, in the subjective judgment of EPA, generally "acceptable" to affected populations in most areas, but to prevent the type of growth (such as very large coal-fired power plants) which generally creates a strong adverse reaction by many local populations.

The increment will permit construction of typical new coal-fired power plants (which must meet New Source Performance Standards and must use stack heights corresponding to good engineering practice) in the range of from 800 megawatts to 1000 megawatts. The variation is due primarily to differing terrain features and meteorological conditions in particular sections of the country, and to specific siting conditions. These data were developed by EPA, and are generally consistent with the studies conducted by other agencies and contractors. The data are somewhat more precise than earlier studies because most earlier studies could not assess the impact of "good engineering practice" stack heights.

The increment will therefore support new power plant units which are slightly larger than the average individual units planned for construction. Testimony provided by a representative of El Paso Natural Gas confirmed that the Class II increment would also not restrict their planned coal gassification facility. Similar analyses indicate that the Class II increment will support larger than average size facilities of other major commercial and industrial activities although large facilities (including oil shale extraction), would likely require redesignation to Class III.

Point 2. The Class II increment would (and should) inhibit construction of unusually large coal-fired power plants, some other unusually large pollution-prone facilities, and large clusters of smaller facilities. Data on new fossil-fuel fired power plants currently planned for construction through 1982 shows that future plants will be substantially larger than those to which the public is currently accustomed. The average new unit size is 570 MW which is nearly double the average size of existing plants. There are 103 new plants planned, with an average size of 970 MW. The largest plant will be 5200 MW. Six plants will be larger than 2500 MW, 22 will be larger than 1500 MW, and 37 will be larger than 1000 MW. Most of these plants will be prohibited from construction in Class II areas.

The large new plants will not be uniformly distributed. The 11 SERC (Southeast) plants will average 1480 MW each, the 28 ECAR (East-Central) plants will average 1160 MW, and the 19 WSSC (Western) plants will average 1050 MW. This trend toward substantially larger new plants, and substantial expansion of existing plants, is expected to continue.

One of the major goals of the "significant deterioration movement" has been to insure that these very large plants are properly controlled and located, but not necessarily prohibited. The plans for "massive coal-fired power plants" were repeatedly referred to in the public debate as specific examples of the type of growth on which public attention should be focused. It is therefore appropriate that the Class II increment should be sized to place these large plants in a category different from that of the smaller plants.

Point 3. The initial designation as Class II will not disrupt construction of most large power plants due to (1) the six-month grace period and (2) the provision for rapid redesignation to Class III. The initial designation will directly affect only those power plants which (1) have not received construction approval prior to six months after promulgation (prior to that time sources are not subject to review for significant deterioration) and (2) have planning schedules which require construction approval before the State can consider redesignation of the local area (after the State has considered redesignation, it is the State decision, not the initial designation, which affects the power plants).

The regulations do not require a State to redesignate its entire territory simultaneously. If a large plant was caught at an inopportune point in its planning cycle, the State could perform the redesignation of the surrounding area very rapidly (assuming that the local population agreed that the redesignation was appropriate).

The original proposal required States to redesignate their entire territory within six months of promulgation. The extensive comments on this feature indicated that six months was insufficient time for most States to assess the total implications of such land use decisions throughout the State. However, 6 months was considered adequate time to assess the desirability of one special facility in one specific local area.

Point 4. The initial designation as Class II would not increase the uncertainty associated with power plant siting. The promulgation of significant deterioration regulations will, in some cases, increase the initial uncertainty associated with siting decisions by involving the local population in the siting decision. (As pointed out by several utilities, the regulations will eventually reduce the uncertainty by providing an a priori indication of local attitudes.)

However, any uncertainty is due solely to the fundamental concept of local involvement in defining "significant." The initial classification may tend to hasten local and State action, but a certain degree of uncertainty will exist until redesignation is accomplished: this uncertainty will exist irrespective of whether the initial designation is Class II or some larger increment. There is no way to guarantee by initial designation that a specific area will not be redesignated as either Class I or Class III.

Point 5. A "Class II increment" which is double the current increment would reduce the options of many States, and could result in more territory being redesignated as Class I. No area has zero pollution. Many non-urban areas have pollutant concentrations of approximately one-third the standards. If faced with a choice between a Class I increment, or a larger Class II increment which would raise them to the national standards, these areas might choose the Class I; whereas they might have preferred the current Class II increment which would permit deterioration only halfway to the standards.

Further, in many areas there is massive resistance to very large power plants and other major pollution-prone facilities. In these areas, the population would likely choose the Class I designation if it was the only classification which would prohibit these large, controversial

facilities. In so doing, it is likely that some forms of desirable growth would also be prohibited as a byproduct.

Point 6. Doubling the Class II increment would require development of entirely new rationale and justification for selection of the new increment. The current increment permits introduction of well-controlled, moderate sized facilities, and excludes the very large pollution-prone facilities which often encounter massive public resistance. The Class II increment is intended to apply to areas of "moderate," "normal," or "average" growth, with populations which have "typical" attitudes toward balancing of environmental and other considerations.

This rationale could not be applied to an increment which would permit introduction of very large power plants. These massive facilities do encounter strong opposition in many areas of the country. They are not "moderate," "normal," or "average," and are not generally acceptable to "typical" populations.

Point 7. To double the Class II increment at this late date without strong justification would likely be viewed with suspicion by the public and disfavor by the Court. The current Class II increment has received extensive debate and general acceptance in the public arena. Although many comments questioned the basic concept of preventing significant deterioration, there were no major challenges to the philosophy that the Class II increment should permit a reasonable amount of growth in most areas of the country, except for challenges that the increment is too large. In fact, there is nothing in the public record that would support doubling of the Class II increment in these regulations.

The Acting Administrator stated in the July 16, 1973, proposal that, in his judgment, "Deterioration above the Zone II levels would constitute ... a significant deterioration in most areas of the country." It is unlikely that the Court, and the public, could be provided any new data or rationale which would justify changing that judgment.

Possibly the most compelling argument against doubling the Class II increment is this pragmatic one: the public would likely view the action as a very transparent cave-in to industrial interests at considerable expense to the environment, and the Court would likely view it as deliberately non-responsive to the court order.

Emissions of Sources Subject to Significant Deterioration Regulations

The 1970 emissions for the 17 largest source categories are shown in Table 1. The total 1970 emissions, excluding sources such as forest fires and agricultural emissions, were: 22.3 million tons for TSP and 33.3 million tons for SO_2. Therefore, existing sources of the type subject to the significant deterioration regulations emitted about 30% of the TSP and 75% of the SO_2 emitted nationwide in 1970.

Table 1 - 1970 Emissions for the 17 Largest Source Categories, tons/yr.

Source Category	TSP	SO_2
Fossil Fuel Fired Steam Electric Power Plants	3,000,000	13,465,000
Coal Cleaning Plants	102,000	
Kraft Pulp Mills	796,000	
Portland Cement Plants	280,000	
Primary Zinc Smelters	22,000	140,000
Iron and Steel Mill Metallurgical Furnaces	817,000	
Primary Aluminum Ore Reduction	74,000	
Primary Copper Smelters	71,000	4,021,000
Municipal Incinerators	450,000	
Sulfuric Acid Plants		1,757,000
Petroleum Refineries	211,000	4,393,000
Lime Plants	523,000	
Phosphate Rock Processing	334,000	
By Product Coke Oven Batteries	153,000	437,000
Sulfur Recovery Plants		750,000
Carbon Black Plants	215,000	
Primary Lead Smelters	1,200	494,000
TOTALS	7,249,000	25,457,000